RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 63 OCTOBER, 1954 No. 4

CONTENTS

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Duodenal Obstruction Due to Annular Pancreas

With a Differential Diagnosis of Other Congenital Lesions Producing Duodenal Obstruction[1]

JOHN W. HOPE, M.D., and JOHN F. GIBBONS, M.D.[2]

AN ANNULAR PANCREAS is simply a band of secreting pancreatic tissue arising from the head of the pancreas and passing around the second portion of the duodenum, although involvement of the third portion has also been reported. If the ring is incomplete, it will take the form of two arms reaching out from the pancreatic head, partially encircling the duodenum and leaving a gap on the ventral surface which is filled with loose fibrous tissue. The degree of obstruction varies from case to case. In some, it is complete, with underlying duodenal atresia, whereas in others there is no obstruction, and the condition is discovered incidentally at autopsy.

In 1933, McNaught (1) reviewed the literature and collected 40 cases of annular pancreas. In 1942, Lehman (2), again reviewing the literature, found 48 cases. Of these, only 10 had been treated surgically. In 1944 Gross and Chisholm (3) reported the first case of annular pancreas in an infant operated upon in this country. Three more cases treated by operation were reported at the end of 1950 by Ravitch and Woods (4), 2 of which were in infants. In June 1951, Payne (5) collected a total of 58 cases, including 1 of his own, of which only 18 had been treated surgically. By February of 1952, Silvis (6) was able to find 26 surgical cases in the literature, to which he added another. Of this group 5 were seen in the neonatal period. Four more surgical cases then appeared in the literature, but these were all in adults (7, 8).

Shapiro, Dzurik and Gerrish (9) later in 1952 reported 4 more cases in infants, bringing the total number to 9. In January 1953, Castleton, Morris and Kukral (10) added another adult surgical case. In June 1953, Gillespie and Moore (11) reported 1 case in an infant and mentioned 2 others to be reported. This made a total of 12 operations in the neonatal period. Gross, in his textbook, *The Surgery of Infancy and Childhood* (12), appearing in the summer of 1953, listed a total of 15 cases from the Boston Children's Hospital, of which 10 were treated surgically. He had already reported the first of this latter group, so that 9 cases in infancy were added.

As of July 1953, there have been reported about 85 cases of annular pancreas, of which number 48 have been operated upon. Of this operated group, 21 cases have been in infants. About half of the cases re-

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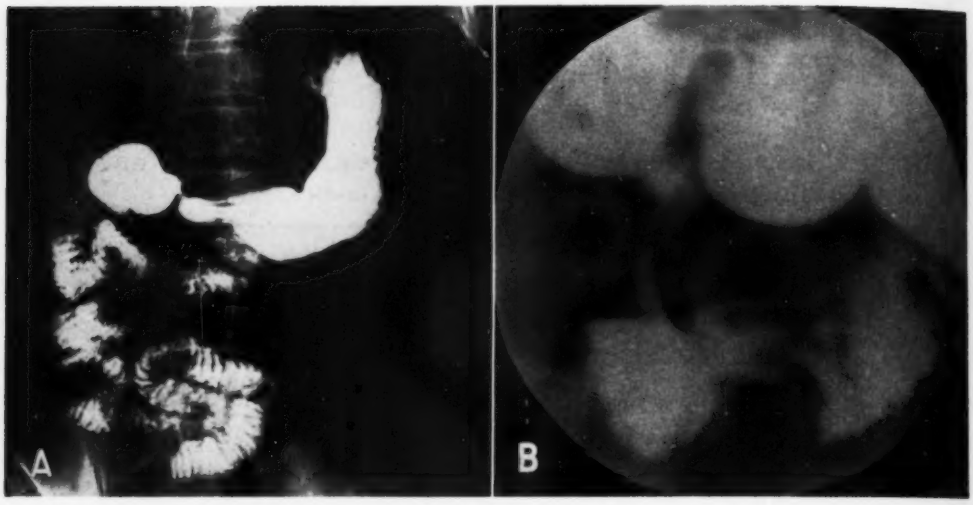


Fig. 1. Case I. A 54-year-old man with epigastric pain for several weeks.
A. Gastrointestinal film showing a dilated duodenal bulb and a constriction of the second portion of the duodenum.
B. Spot film showing to better advantage the constriction of the second portion of the duodenum, caused by an anomalous ring of pancreatic tissue.

ported were incidental findings at autopsy.

While the reporting of this anomaly has been increasing in frequency in the surgical literature, there is a conspicuous absence of such reports in the radiological literature. The writers have succeeded in finding but three references in American radiological journals (13, 14, 15). Even in Poppel's excellent book (16), *Roentgen Manifestations of Pancreatic Disease*, only two and one-half pages are devoted to this anomaly.

In the last three years, it has been our good fortune to see 8 cases of annular pancreas, only 1 of which occurred in an adult. Of the 7 infants, 6 were operated upon; the remaining case was an incidental autopsy finding. Until the appearance of Gross' book, we had thought that our experience was unique, and so, in a sense, it is, since the 7 infants were seen within two years time, July 1951–July 1953. Our 7 operated cases bring the total surgical cases up to 55, of which 27 have been in the neonatal period. The fact that almost as many infants have been operated on as adults is of interest, since up until now the condition has been thought to occur more frequently in adults. This unquestionably reflects a growing trend in pediatric surgery. Patients that only a few years ago would probably have been allowed to die of some vague abdominal disorder are now being studied and often cured. Since radiology offers the closest approach to a diagnosis, or at least a presumptive diagnosis, radiologists should be aware of the anomaly and prepared to offer advice for the patient's welfare.

CASE REPORTS

CASE I (Fig. 1): A 54-year-old man entered Bryn Mawr Hospital (Bryn Mawr, Penna.), on the service of Dr. Charles A. Steiner, in September 1950, complaining of epigastric pain of several weeks duration, unrelieved by conservative medical measures. A gastrointestinal series (Fig. 1, A and B) showed a constricting lesion of the descending portion of the duodenum with duodenal dilatation proximally. A definite diagnosis was not arrived at, but the patient was thought to have either an intrinsic carcinoma of the duodenum or an extrinsic lesion, such as a carcinoma of the head of the pancreas.

Operation revealed a ring of pancreatic tissue encircling the second portion of the duodenum. The anterior segment of the ring measured 1.5 cm. wide by 1 cm. thick. This was palpated to rule out the possibility of any major duct being present in its substance and was divided. The duodenum then presented an hour-glass appearance, but the

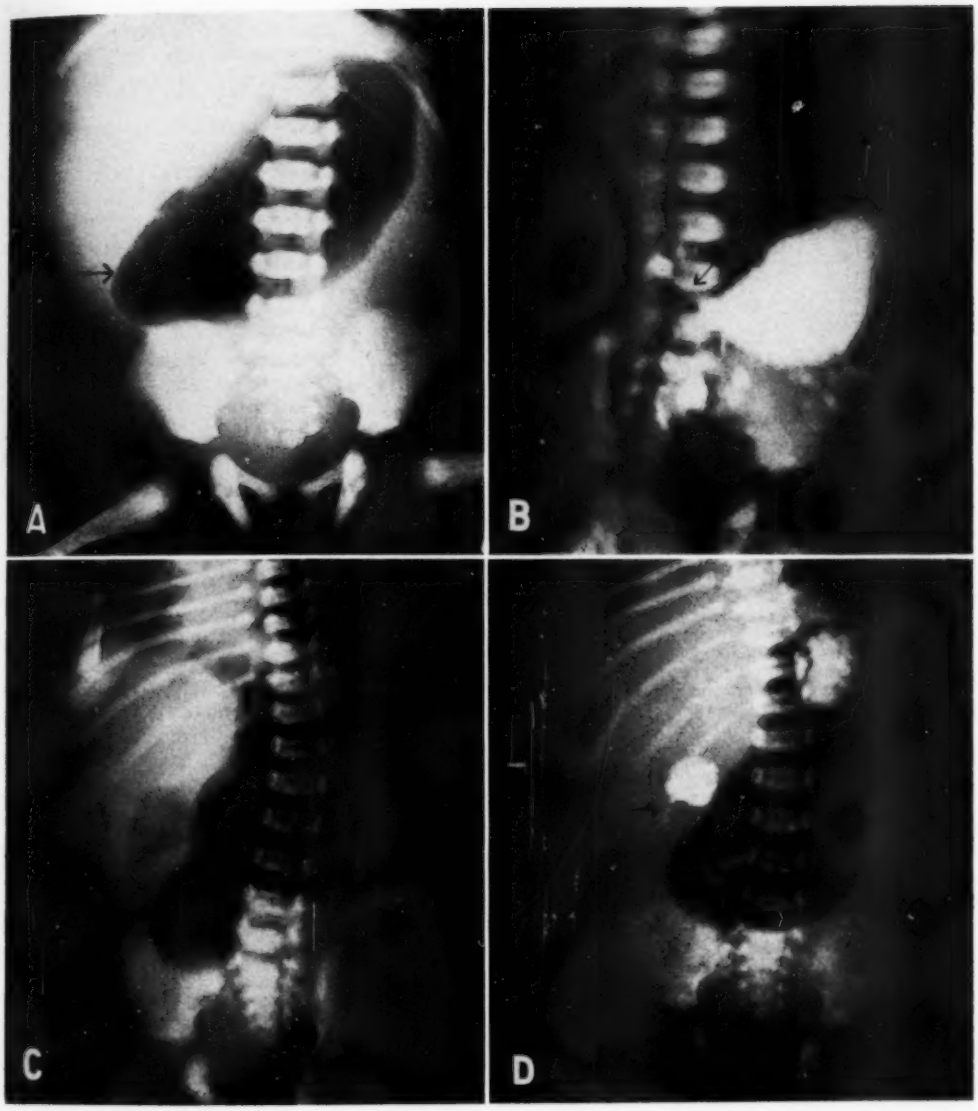


Fig. 2. Case II. A two-week-old mongolian idiot, blue from birth.

A. Portable film obtained on fourth day after admission, showing distended stomach and air in the duodenal bulb. No attention was originally paid to the small droplets of air (arrow) at the junction of the second and third portions of the duodenum.

B. Portable gastrointestinal film. The arrow points to what was interpreted as a "string" sign of pyloric stenosis. No attention was paid to the absence of contrast medium between the duodenal bulb and the lower half of the second portion of the duodenum. It was at this site that an annular pancreas encircled the duodenum.

C. Portable film taken on the fifth postoperative day, following section of the anterior annular portion of the pancreas. The obstruction is still present. Again small air bubbles can be seen at the same location as in A (arrow).

D. Portable film taken on the sixth postoperative day, with Iodochlorol in the stomach. Note the large duodenal bulb and the narrow constricted second portion of the duodenum (arrow). This constriction is due to the annular pancreas. Simply cutting the anterior ring did not relieve the obstruction.

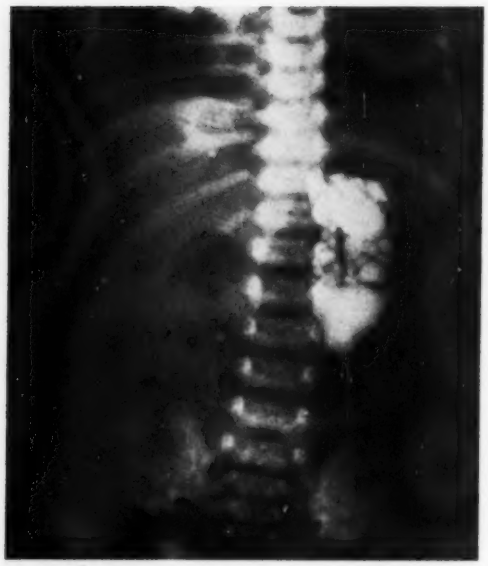


Fig. 3. Case III. A five-day-old male with vomiting since birth. Portable film obtained eight hours after Iodochlorol was placed in the stomach, showing dilated duodenal bulb with some air further on in the second portion of the duodenum (arrow) and absence of air between the two (cf. Fig. 2A and C). The zone between the two bubbles of air proved at autopsy to be the site of an annular pancreas.

constricted portion gradually unfolded and dilated to a normal size. Microscopic examination of the resected segment of pancreas showed normal pancreatic tissue.

The patient was discharged in good condition but epigastric pain again developed, and a repeat gastrointestinal series showed a similar constriction of the second portion of the duodenum. In March 1951, five months after the first operation, the patient was again operated upon and a recurrence of the annular pancreas was found, with a small pseudocyst. The annular portion was again removed, with the cyst, and a duodenojejunostomy was done. The patient then became symptom-free and has remained so to the time of writing (July 1953).

CASE II (Fig. 2): A 2-week-old white male mongolian idiot was admitted to the Children's Hospital of Philadelphia on Aug. 2, 1951, having been blue since birth. Beginning with the first feeding, the infant had vomited everything taken by mouth. A roentgen examination of the chest showed bilateral aspiration pneumonitis with multiple patches of atelectasis. On Aug. 6, a film of the abdomen (portable) showed a distended air-filled stomach and air in the duodenal bulb (Fig. 2A). No attention was paid to the few small bubbles of air seen further on, near the junction of the second and third portions of the duodenum (indicated by the arrow on Fig. 2A).

The infant was in such a poor condition that we were asked to do a portable gastrointestinal series, using Iodochlorol, with the baby inside an isolette. A film of this study (Fig. 2B) shows a very obvious "string" sign of pyloric stenosis. No consideration was given to the absence of the contrast medium between the duodenal bulb and the lower half of the second portion of the duodenum.

The child was operated upon for a pyloric stenosis and an annular pancreas was found encircling the second portion of the duodenum just beyond the bulb. The anterior portion of the pancreatic ring was divided, and air injected into the stomach flowed freely through the duodenum.

The postoperative course was stormy, with continued vomiting and the development of jaundice. A portable film (Fig. 2C), obtained on the fifth postoperative day, showed almost no air beyond the bulb except for the few small bubbles again seen further on in the horizontal portion of the duodenum.

On the following day, some Iodochlorol was placed in the stomach and a roentgenogram of the abdomen was taken (Fig. 2D). This showed a narrow constriction just beyond the duodenal bulb at the site where the encircling pancreas had been sectioned. On the next day, Aug. 14, an anterior gastrojejunostomy was performed, but the baby stopped breathing about eight hours after surgery. Autopsy showed an almost complete stenosis of the duodenum where it had been encircled by pancreatic tissue.

CASE III (Fig. 3): On Aug. 1, 1951, a five-day-old Negro male was admitted to the Children's Hospital because of vomiting since birth. Films taken prior to admission, at another hospital, indicated a duodenal atresia. On the day of admission, the child was operated upon and a duodenal atresia was seen just beyond the bulb. Below the area of narrowing the duodenum contained bile. A duodenojejunostomy was performed.

The subsequent course was stormy, with icterus developing on the first postoperative day. On the fourth day oral feedings were resumed and vomiting continued. On the seventh day a portable film of the abdomen (Fig. 3) was obtained eight hours after some Iodochlorol had been placed in the stomach. This examination showed the medium still in the stomach and revealed a large duodenal bulb. Some air was seen in the second portion of the duodenum, near its junction with the third portion, but no air was present between the bulb and this region.

On Aug. 8 a second operation was done, and air from the stomach was easily forced through the duodenojejunostomy. An anticolic, antiperistaltic gastrojejunostomy was carried out, even though the original stoma appeared patent. Following this

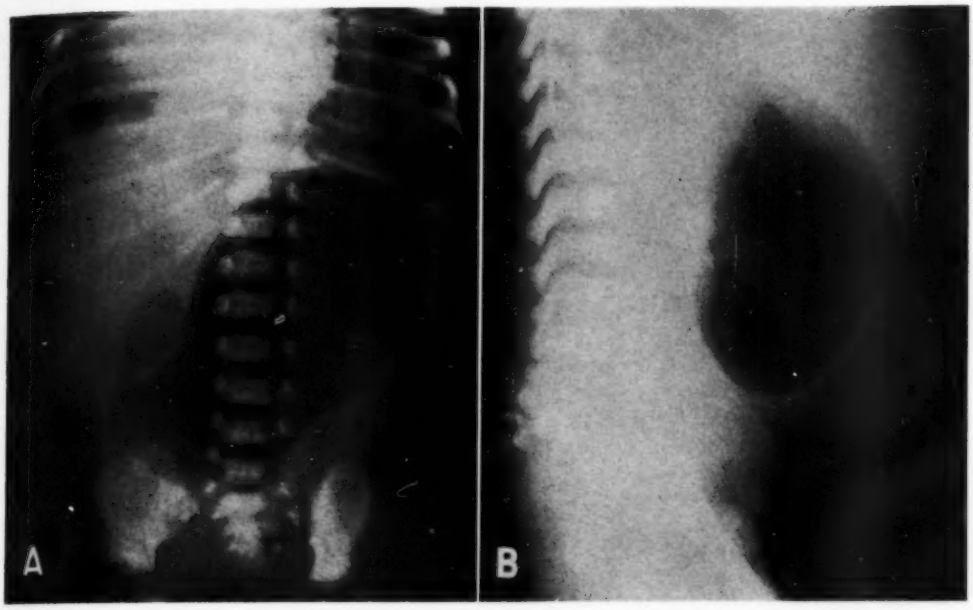


Fig. 4. Case IV. A six-day-old female admitted with the diagnosis of tracheoesophageal fistula.
A. Distended air-filled stomach and a somewhat distended air-filled duodenal bulb with no air beyond the latter.
B. Lateral view, showing a complete absence of air beyond the duodenal bulb. These findings are diagnostic of duodenal atresia. In this case the atresia was due to an annular pancreas which encircled the duodenum just proximal to the ampulla of Vater.

second procedure, x-ray examination showed air in the colon and several bowel movements occurred. Because of evisceration, the wound had to be resutured on Aug. 12. Death occurred four days later.

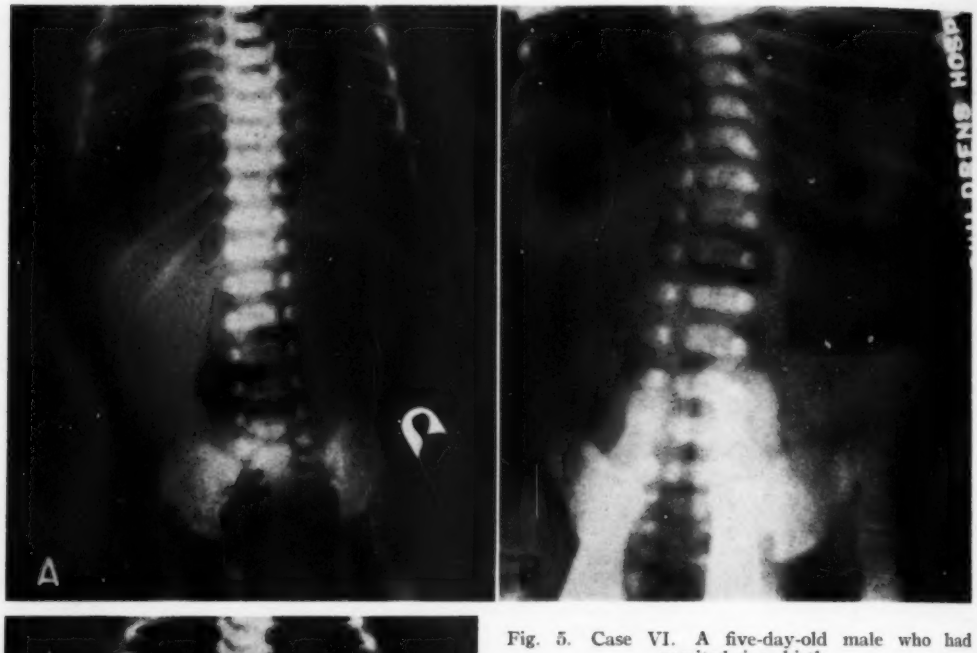
At autopsy an annular pancreas encircling the second portion of the duodenum was discovered. This had caused almost complete atresia of the duodenum; air could be forced from the stomach through the stenotic area, but even a small probe would not pass.

CASE IV (Fig. 4): A 6-day-old white female was admitted to the Children's Hospital on Sept. 29, 1951, with the diagnosis of tracheoesophageal fistula. Under the fluoroscope a catheter was passed into the upper esophageal pouch, and the diagnosis of esophageal atresia was confirmed. A roentgen examination of the abdomen (Fig. 4, A and B) showed a distended air-filled stomach and a somewhat distended air-filled duodenal bulb, with no air beyond. This was considered diagnostic of duodenal atresia. The presence of air in the stomach confirmed a communication between the lower end of the esophagus and the trachea.

Operation was undertaken immediately; the tracheoesophageal fistula was closed and an esophagoesophagostomy was done. Two days later distention was present because of the duodenal atresia, and a posterior gastroenterostomy and gastrostomy were performed. At the time of this operation all of the organs in the abdomen were edematous and it was difficult to identify the various tissues. Two days after the second operation, the esophageal anastomosis began to leak, and a pneumothorax developed. The child died Oct. 3, 1951.

At autopsy an annular pancreas was found encircling the duodenum just proximal to the ampulla of Vater. No lumen of the duodenum could be demonstrated at this site, so that a complete atresia lay beneath the annular pancreas. Minute openings were found in the esophagus at the site of the anastomosis and in the trachea where the fistula had been tied off.

CASE V: A 3-month-old white male was admitted Nov. 3, 1951, because of almost continuous convulsive seizures. A pneumoencephalogram revealed severe cortical atrophy and a possible subdural hematoma on the left. On Nov. 21, a left fronto-parieto-temporal craniotomy was performed. When the brain was exposed, it was smooth, with no convolutions. Death occurred shortly after surgery, and autopsy revealed a severe cerebral agenesis with marked atrophy of the white matter. In addition, an annular pancreas was present, beginning below the ampulla of Vater and extending



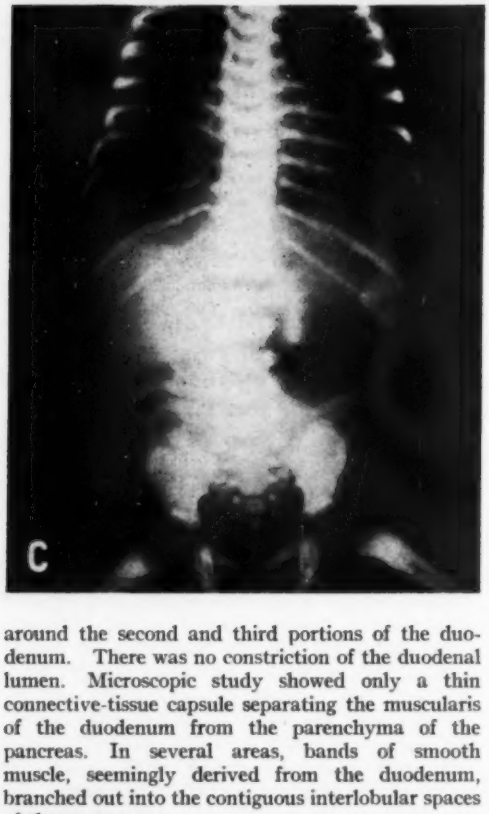


Fig. 5. Case VI. A five-day-old male who had vomited since birth.

A. Roentgen examination of the abdomen in the supine position shows a distended air-filled stomach with no air in the small bowel. The little air present in the rectum is due to several rectal examinations and enemas.

B. Examination in the erect position shows air and fluid levels in both the stomach and the duodenal bulb, which is the picture of duodenal atresia. In this case the atresia lay beyond an annular pancreas and there was also a complete malrotation of the bowel.

C. Roentgen examination on the fourth postoperative day following a gastrojejunostomy shows air in the jejunal loops, which lie in the right upper quadrant, as would be expected in the presence of complete malrotation.

around the second and third portions of the duodenum. There was no constriction of the duodenal lumen. Microscopic study showed only a thin connective-tissue capsule separating the muscularis of the duodenum from the parenchyma of the pancreas. In several areas, bands of smooth muscle, seemingly derived from the duodenum, branched out into the contiguous interlobular spaces of the pancreas.

CASE VI (Fig. 5): A 5-day-old Negro male was admitted on March 30, 1952, having vomited since birth. A roentgen examination of the abdomen showed both the stomach and the duodenal bulb distended with air (Fig. 5, A and B). A little air was present in the rectum, but the infant had been given several enemas prior to being brought to the hospital. The picture was that of duodenal atresia but, because we had recently seen so many cases of annular pancreas, this was suggested as a possible cause. The baby was operated upon and the entire small bowel was deflated beyond the duodenal bulb. There was a complete lack of attachment of the mesentery of the small bowel and of the right colon, with the cecum in the midline of the upper abdomen. The duodenum was visualized, showing an annular pancreas encircling the second portion just beyond the distended duodenal bulb. Beyond the annular pancreas the duodenum was atretic for a distance of some

3 inches. A gastrojejunostomy was carried out. The child did extremely well following surgery and on the fourth postoperative day a roentgen examination showed air within the jejunal loops beyond the anastomosis (Fig. 5C). The jejunum lay in the right upper quadrant, where one would expect it to be because of the malrotation.

The patient was doing well and passed several stools, when suddenly, on April 6, vomiting occurred, with aspiration. Death ensued the following day. A postmortem study confirmed the aspiration pneumonitis and showed the annular pancreas encircling the duodenum just beyond the first portion. The bowel was atretic beyond this region for a distance of some 3 inches. The anastomosis between the stomach and the duodenum was found to be patent.

CASE VII (Fig. 6): A 3-month-old white female was admitted on Jan. 13, 1953, with a history of vomiting of one month duration. She had been well for the first two months of her life, when she began to vomit once daily. On arrival at the Children's Hospital, she was critically ill, with an elevated non-protein nitrogen and low chlorides. A roentgen examination of the abdomen led to a diagnosis of malrotation of the colon, but the stomach was full of fluid (Fig. 6A), so that the level of the obstruction was not determined. It was suspected that with the malrotation of the colon there would be a duodenal band. The abdomen was opened and a large dilated thick-walled stomach was found, with a huge duodenal bulb. A stenosis was present in the third portion of the duodenum, where it was crossed by a band attached to the cecum, which lay in the middle of the upper abdomen. The stenosis was not complete, as air could be forced through the duodenum. An annular pancreas was found just proximal to the stenotic area. No ligament of Treitz was present. The duodenal band was cut and the colon allowed to hang from the mesocolon. A side-to-side posterior duodenojejunostomy was done.

On the third postoperative day glucose water was given by mouth and the baby began to vomit. A gastrointestinal series with Iodochlorol was done on Jan. 20, showing the huge duodenal bulb which had been seen at the time of surgery and which we originally failed to visualize because the stomach was full of fluid (Fig. 6B). The stomach was studied at periodic intervals under the fluoroscope, and at two and one-half hours a little of the contrast medium could be seen passing through the stoma of the duodenojejunostomy (Fig. 6C). It was apparent that this was not adequate function, and the abdomen was reopened. The stoma was found to be wide open, and fluid and air could be forced through it. A gastrojejunostomy was done.

Again vomiting took place as soon as fluids were given by mouth. A roentgen examination five days after the second operation showed the stomach and duodenal bulb almost filling the abdomen (Fig. 6D). On Jan. 27, a third exploration was undertaken. Both anastomoses were found to be patent, but an intussusception of the jejunum was also discovered. This was reduced and a subtotal gastric resection with a gastrojejunostomy was carried out. Following this procedure the baby did well and has continued to do so until the present time.

CASE VIII: A 7-day-old white female was admitted to the Children's Hospital on May 29, 1953, having vomited since birth. A gastrointestinal series had been attempted at another hospital, and when we saw the infant, twenty-four hours later, most of the barium still lay in the stomach and in a large dilated duodenum. The duodenum was dilated in its proximal portion, gradually narrowing as the ligament of Treitz was approached. Some barium had passed into the jejunum. A diagnosis of partial duodenal obstruction due to malrotation and probable duodenal bands was made. The possibility of an annular pancreas was suggested. The child also had congenital abnormalities of the upper thoracic and cervical spine and a Sprengel's deformity of the right scapula. The heart was shifted to the right side of the chest due, we thought, to an agenesis of the upper and middle lobes of the right lung. At operation an incomplete rotation of the large bowel was found, with a thick, fibrous peritoneal band crossing the fourth portion of the duodenum near the ligament of Treitz. A true annular pancreas was also present, but this surrounded the dilated second portion of the duodenum and was not causing any degree of obstruction. The duodenal band was cut, and the ligament of Treitz freed to allow the small bowel to be on the right and the large bowel on the left. The baby continued to vomit after this operation, and a film of the abdomen showed no air in the bowel beyond the duodenum. The abdomen was opened again on the fifth postoperative day, and a stenosis of the duodenum was found at the site of the sectioned duodenal band, due to intrinsic fibrosis of the bowel wall. A side-to-side anastomosis was done between the first and fourth portions of the duodenum to circumvent the obstruction. Following the second procedure, the baby became asymptomatic and has done well to the present time.

EMBRYOLOGY

McNaught (1) and Howard (17) have written extensive discussions of the development of annular pancreas. From Cunningham's *Anatomy* (18) a good discussion of the embryology of the pancreas itself may be obtained. In man the pancreas is developed very early from two

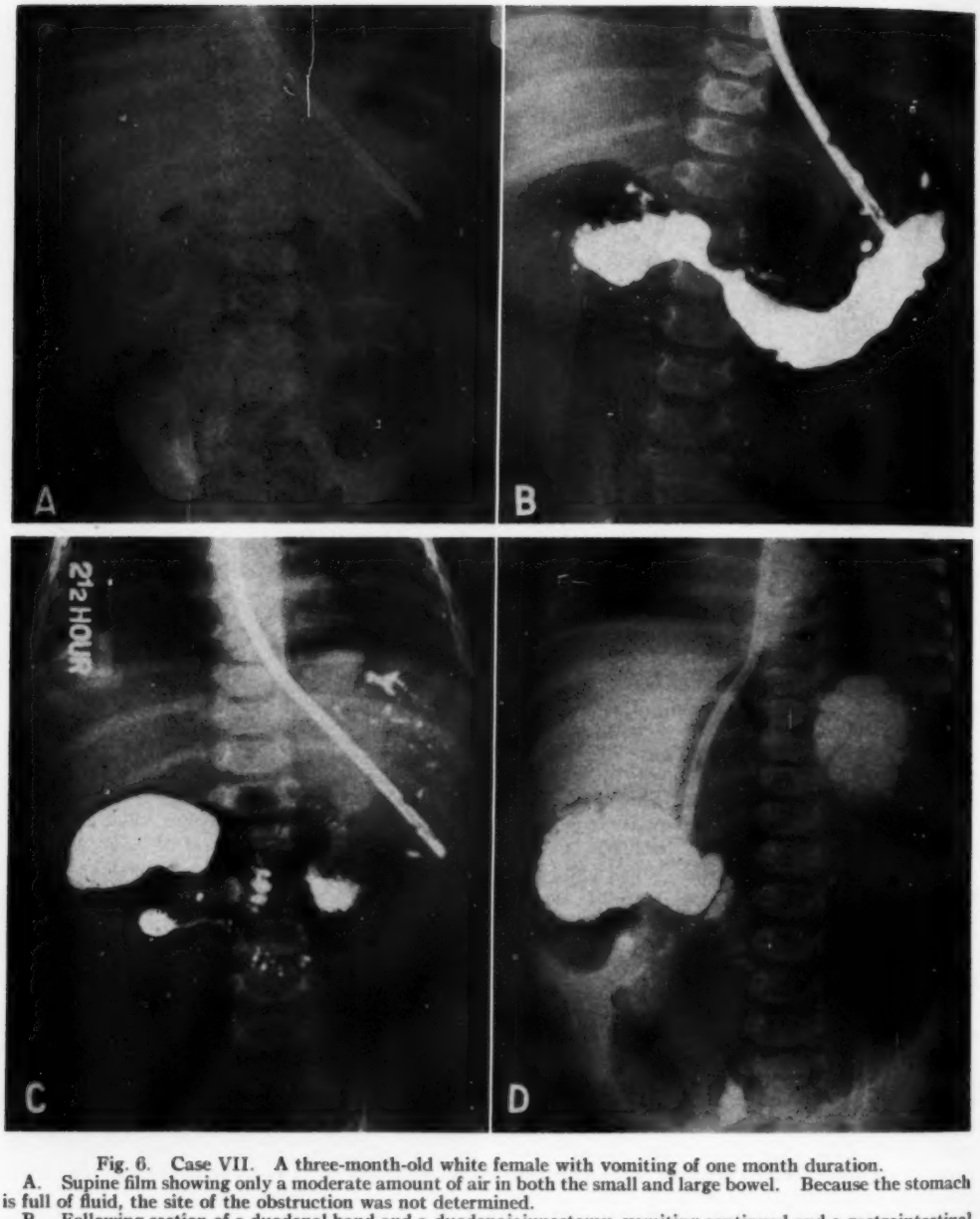


Fig. 6. Case VII. A three-month-old white female with vomiting of one month duration.

A. Supine film showing only a moderate amount of air in both the small and large bowel. Because the stomach is full of fluid, the site of the obstruction was not determined.

B. Following section of a duodenal band and a duodenojejunostomy, vomiting continued and a gastrointestinal series using Iodochlorol was performed. This film shows the huge duodenal bulb which was hidden originally by fluid.

C. Film taken two and one-half hours after giving the Iodochlorol, showing a little of the medium passing through the stoma of the duodenojejunostomy. Again note the huge duodenal bulb.

D. Film taken five days after a second operation (gastrojejunostomy). The stomach and duodenal bulb almost fill the abdomen.

outgrowths of the alimentary canal known as the dorsal and ventral anlage. The dorsal anlage grows from the roof of the primitive duodenum and forms the future body and tail of the pancreas, and its duct becomes the accessory duct of Santorini. The ventral anlage grows a little later from the anterior surface of the gut at the root of the liver outgrowth and forms the major part of the head of the pancreas and the uncinate process, and its duct is the main pancreatic duct of Wirsung.

Through the rotation of the duodenum around its long axis, the dorsal and ventral rudiments approach each other and in the sixth week fuse to form the adult pancreas. It is at this stage of development that the anomaly known as annular pancreas is thought to arise.

Brown, Bingham and Cronk (19) state that the majority opinion concerning the mode of origin of the anomaly is that it represents a failure of complete migration of the ventral anlage of the gland first to the right and then posteriorly to the duodenum to fuse with the dorsal anlage. Because of this, a tip of the ventral anlage remains in an anterior position while the duct outlet rotates normally. A band of pancreatic tissue therefore becomes wrapped about the duodenum in napkin-ring fashion, and the duct from the ventral anlage sweeps around the duodenum.

The annular portion of the pancreatic substance has all the histologic characteristics of a normal pancreas. Because of the surgical implications, the ducts of the annulus have been the subject of considerable investigation. They may be rudimentary and run from the anterior part of the ring toward the left to join the main pancreatic duct. It is more usual, however, for the annular pancreas to be transversed by a major duct which begins anteriorly, runs to the right, then curves around laterally and posteriorly, finally to join either the common bile duct or the main pancreatic duct.

CLINICAL SYMPTOMS

Because the degree of obstruction varies from case to case, the symptomatology also varies. If the obstruction is complete, with underlying atresia of the duodenum, the picture will be that of acute high obstruction. If the obstruction is minimal, the symptoms will be those of recurrent partial obstruction. If there is no obstruction at all, the patient may remain asymptomatic throughout life, the annulus being found incidentally at autopsy. In the adults operated upon, epigastric pain has been a common symptom, as in our Case I. A great many of these older patients have shown varying degrees of pancreatitis. This not only may explain the epigastric pain, but also may account for the late onset of symptoms. It has been somewhat of a mystery why a person may go forty or fifty years with no obstructive symptoms, after which, for no clear reason, the annular pancreas, which has been present since birth, begins to obstruct the duodenum. It may be that the development of acute pancreatitis, with swelling of the head of the gland, compresses the duodenum sufficiently to produce obstructive symptoms. This has been suggested by several previous writers (2, 10). It seems a logical answer to the mystery.

In infants, vomiting is the chief symptom. Obviously, if symptoms develop in the neonatal period, the degree of obstruction must be severe, as shown by our Cases IV and VI, in which duodenal atresia was complete.

The frequency of other congenital anomalies should be mentioned. Other authors presenting cases in the neonatal period have also stressed this finding. Only 1 of our 7 infants had no other congenital defects.

ROENTGEN FINDINGS

The diagnosis, or at least the presumptive diagnosis, of this ailment should be made by the radiologist. The only reason the diagnosis is not made is because the condition is not thought of by the examiner. It is true that, because of the varying degrees of obstruction, there is no one

roentgen sign to be depended upon. There are, however, a number of signs which should make us sufficiently suspicious to offer a possible diagnosis.

As shown by Cases I (Fig. 1) and II (Fig. 2D) in our series, there may be a concentric smooth narrowing of the duodenum at the site of the annulus. Since most of these anomalies are in the second portion of the duodenum, this would be the area most commonly involved. There is also dilatation of the duodenum proximal to the narrowed zone. Lehman (2) observed a smooth indentation constricting the second portion of the duodenum on the right side. Whether the constriction is concentric or only on the right, annular pancreas should be thought of as a possible diagnosis.

Our Cases II (Fig. 2) and III (Fig. 3) showed a finding on the plain films which we feel is significant. Each of these cases showed a dilated air-filled stomach and a dilated air-filled duodenal bulb; no air could be seen in the descending second portion of the duodenum, but at about the beginning of the third portion some air bubbles were present. We adopted the term "double-bubble" sign for this finding, and were surprised, upon reading Shapiro, Dzurik, and Gerrish's article (9), to find they too used this term. As used by them, however, it describes only air in the stomach and in the duodenal bulb, which is actually the finding seen in duodenal atresia. It is true that some cases of annular pancreas do show a complete duodenal atresia (Cases IV and VI), but where the annulus has produced only a partial stenosis, some air will get by the obstruction. This is our meaning of the designation "double-bubble." To present this difference, we have included roentgenograms (Fig. 7) of a case of duodenal atresia in a four-day-old female who had vomited since birth. As can be seen from all four of the views, there is air in the stomach and in the duodenal bulb, but no air beyond the bulb. At operation, a complete atresia of the second portion of the duodenum was found. A left lateral decubitus view (Fig. 7C) and an upside-down view (Fig. 7D) both show air passing through the pylorus. This is the picture of duodenal atresia. We feel that the presence of a few small bubbles of air further on in the duodenum would indicate a partial obstruction and that, if these are present, an annular pancreas should be mentioned as a possibility.

Before leaving the roentgen findings, we would emphasize the importance of plain films for studying the abdomen when there is any question of obstruction. In infants this becomes extremely important because of the problem of aspiration. If a diagnosis can be reached without the use of a radiopaque medium, we feel that the baby has a better chance of surviving. Air as a contrast medium does no harm and, if properly employed, can usually lead to the diagnosis. Shapiro, Dzurik, and Gerrish also discussed this point, but it is sufficiently important for re-emphasis. The roentgenograms reproduced in Figure 8 are those of a five-day-old female who had vomited since birth. Supine and erect plain films (Fig. 8 A and B) showed only a little air in the stomach; the site of the obstruction was not visualized. The fluid was removed from the stomach and about 50 c.c. of air were introduced through the same catheter. Another set of films was then obtained, and these show air as far as the duodenal bulb and on into the descending portion of the duodenum (Fig. 8 C and D). A diagnosis of duodenal obstruction due to duodenal bands or a possible annular pancreas was made. At operation, a malrotation of the colon was found, with a duodenal band across the third portion of the duodenum. This is only one of a number of cases in which we have employed air for contrast. With erect, supine, both decubitus, and sometimes upside-down films, we usually are able at least to tell the surgeon where the obstruction lies.

DIFFERENTIAL DIAGNOSIS

This discussion of differential diagnosis will include only the congenital anomalies

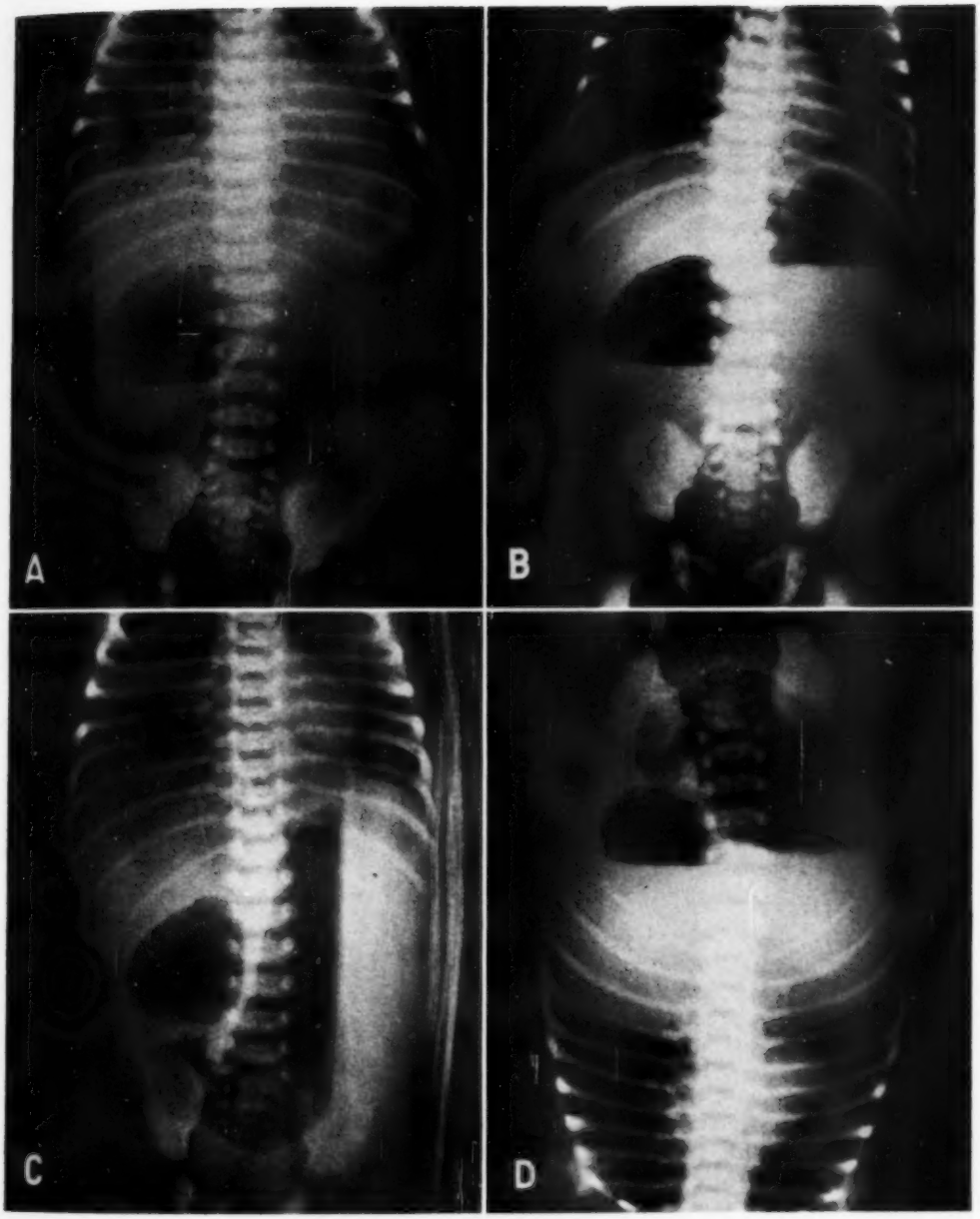


Fig. 7. A four-day-old female with vomiting since birth.

A. Supine film of the abdomen showing a huge air-filled stomach and duodenal bulb.

B. Erect film showing fluid levels in both the stomach and dilated duodenal bulb.

C. Left lateral decubitus film, showing connection between the antrum of the stomach and the duodenal bulb.

D. Film taken with the child held upside-down, showing air in the pylorus entering the duodenal bulb. At operation a complete atresia of the second portion of the duodenum was found.

These four illustrations are typical and diagnostic of duodenal atresia.

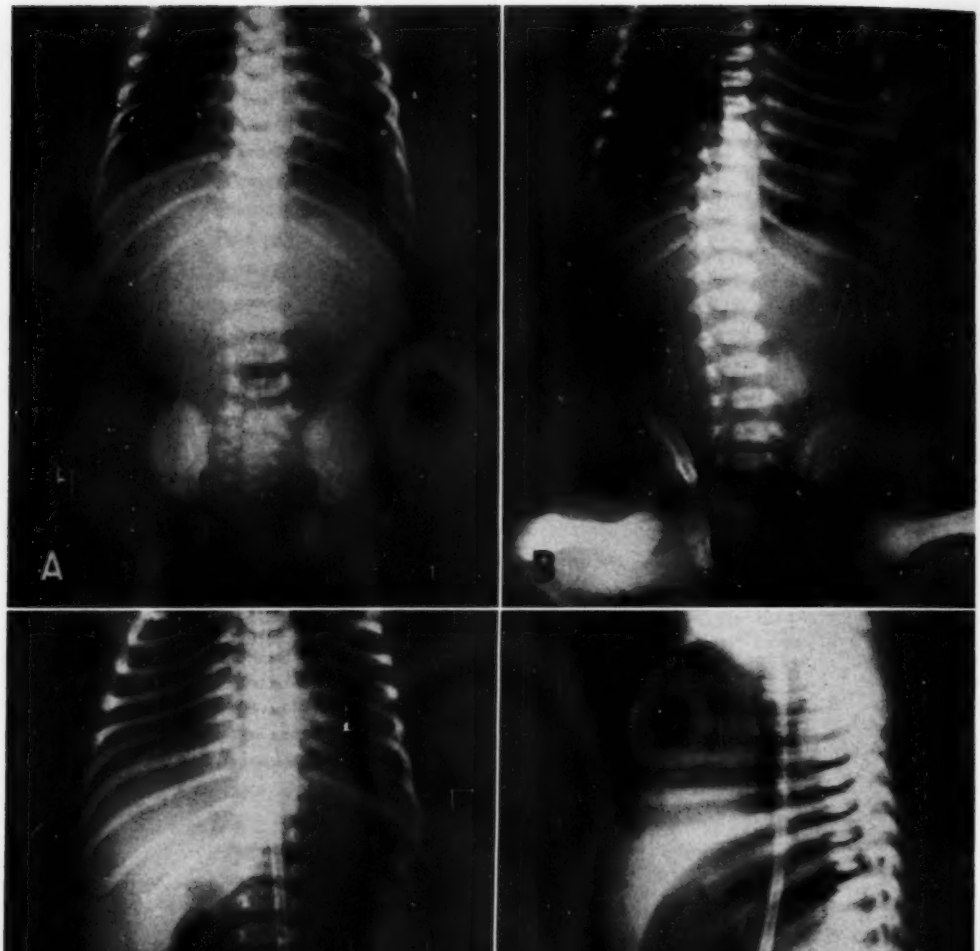


Fig. 8. A five-day-old female, with vomiting since birth.

A. Supine film of abdomen showing only a little air in the stomach.

B. Erect film showing the air bubble in the fundus of the stomach. The rest of the stomach is hidden by the contained fluid.

C. Film obtained after removal of 50 c.c. of fluid from the stomach and the introduction of air through the same catheter. Air can be seen in the entire stomach and on into the duodenal bulb and descending portion of the duodenum.

D. Lateral view of the abdomen taken at the same time as C, showing the air in the descending duodenum better than the anteroposterior view.

which may occur in infancy. The most common cause of obstruction of the duodenum in our experience has been duodenal bands, usually occurring with incomplete rotation of the colon. A case demonstrating this condition is shown in Figure 9. The patient was a seven-month-old male with a history of failure to gain weight and vomiting since birth. A large dilated duodenal bulb is seen just distal to which is

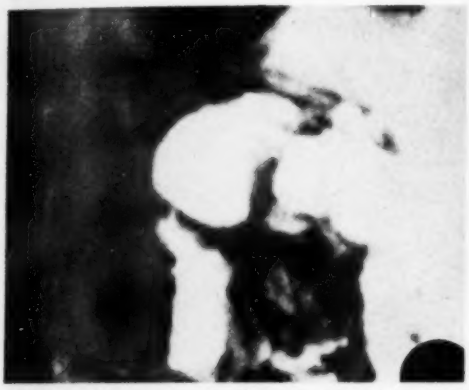


Fig. 9. A seven-month-old male with a history of failure to gain weight and vomiting since birth. The film shows a large dilated duodenal bulb with a definite area of narrowing just distal to the bulb. Violent peristalsis in the bulb could be seen under the fluoroscope. A diagnosis of a duodenal band was confirmed by operation. This is the region where an annular pancreas might be present, but the zone of constriction is believed to be too narrow for that diagnosis.

a definite area of narrowing. Below this the duodenum broadens out to normal caliber. Under the fluoroscope, violent peristalsis was observed down as far as the point of narrowing of the duodenum. A diagnosis of a duodenal band was made and confirmed at operation. The band was cut and the child has done well.

This case has been used intentionally because the duodenal narrowing is exactly in the position where an annular pancreas would be expected to lie. Our reason for calling it a band rather than an annular pancreas is that the constricted zone is narrow. So far we have not seen nor have we read of a case of annular pancreas producing such a narrow ring of constriction. Undoubtedly some day a case will be described, but a surer diagnosis, we believe, is duodenal band.

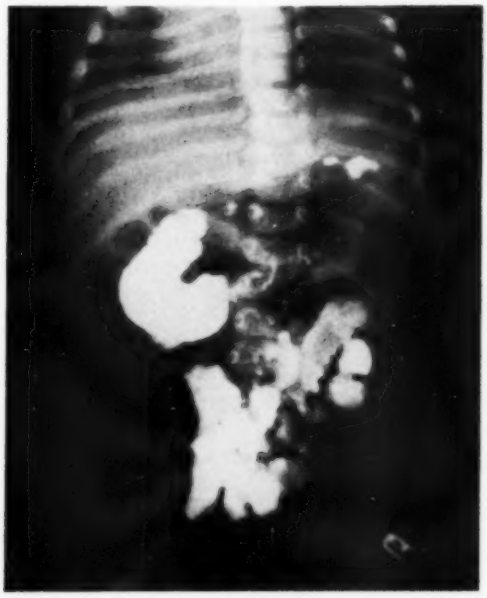


Fig. 10. A five-week-old male with vomiting since birth. The film shows a partial obstruction of the duodenum near the junction of the third and the fourth portions. Active peristalsis was observed down as far as the obstruction. Operation revealed a malrotation of the colon with a duodenal band across the duodenum at the site of the obstruction.

The majority of duodenal bands we have seen have occurred across the third portion of the duodenum associated with incomplete rotation of the colon, with the tip of the cecum held high up in the epigastrium. Figure 10 is a good illustration of this more common anomaly. The patient, a five-week-old male, had vomited since birth. A gastrointestinal series showed a partial obstruction of the duodenum near the junction of the third and fourth portions. Active peristalsis was observed down as far as the obstruction. Operation revealed a malrotation of the colon with a duodenal band at the site of the obstruction.

In some cases of complete malrotation of the bowel a volvulus of the duodenum may occur. A 14-year-old boy had been operated upon several times during infancy for intestinal obstruction. A diagnosis was made of complete malrotation of the bowel. The cecum was removed, and the ileum was anastomosed with the trans-

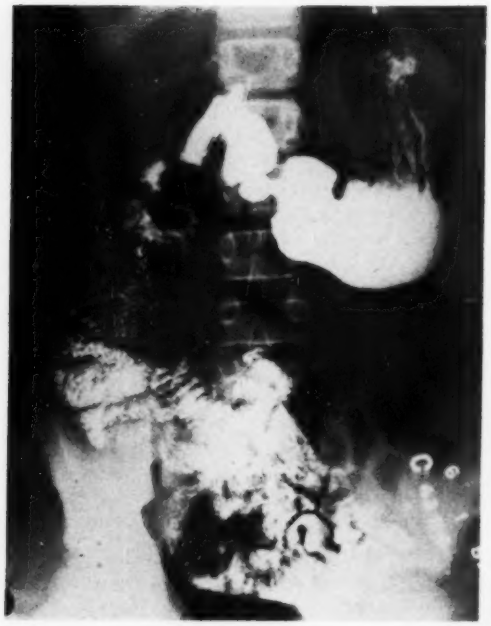


Fig. 11. A 14-year-old boy admitted because of periodic abdominal pain and vomiting. At operation in infancy a complete malrotation of the bowel had been found, the cecum had been removed, and the ileum anastomosed with the transverse colon. Since then there had been frequent episodes of high intestinal obstruction. This film shows the jejunum in the right upper quadrant. Note the "S" shape of the duodenum, with evidence of partial obstruction in the first loop of the "S."

verse colon. This relieved the obstruction, but during the intervening fourteen years there had been frequent episodes of what sounded like high intestinal obstruction. These were always relieved by assumption of the knee-chest position. An upper gastrointestinal examination was done at the age of fourteen and Figure 11 shows the jejunum in the right upper quadrant, as one would expect with a complete malrotation. The more significant finding is the "S" shape of the duodenum, with evidence of partial obstruction in the first loop of the "S." At operation the duodenum was found to be exactly as pictured roentgenologically, being held in this position by thick fibrous bands. At intervals these loops of the duodenum would volvulate, giving rise to obstruction. The bands were cut and the duodenum allowed to hang free on the right side of the abdomen. It has now been two years since this operation and the patient has been completely free of pain.

Atresia of the duodenum has been our next most frequent cause of duodenal obstruction. This has already been discussed and illustrated (Fig. 7).

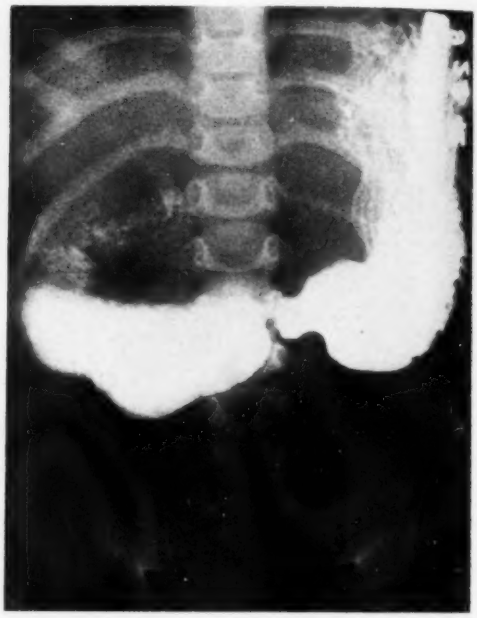


Fig. 12. A 31-month-old female with a history of vomiting spells since infancy. The film shows a huge duodenum, almost as large as the stomach. At operation a web-like membrane was found within the lumen of the duodenum just proximal to the ligament of Treitz. A pin-point opening was found in the center of the web which was large enough to have maintained life for thirty-one months. This illustration does not show the site of the obstruction, but indicates how large the duodenum can become when there is a chronic partial obstruction.

In our experience a web or membrane across the lumen of the duodenum is a rare anomaly, but it must be thought of when dealing with high obstructions. Figure 12 illustrates the case of a thirty-one-month-old female who was admitted with a history of vomiting spells since infancy. A large duodenum was visualized, actually almost the size of the stomach Within the duodenal lumen was a web-like membrane just proximal to the ligament of Treitz, containing a pin-point opening large enough to have maintained life for

thirty-one months. We have not had enough experience with this anomaly to attempt its differentiation from duodenal bands. The case illustrated is unusual and undoubtedly rare. It does, however, show the effect of a long-standing partial obstruction and how the bowel under such circumstances can dilate. The membrane was incised and the child has grown to be a healthy fourteen-year-old girl.

In completing a differential diagnosis of congenital lesions producing duodenal obstruction, paraduodenal hernias should be mentioned. Actually these involve the small bowel distal to the duodenum, but the obstruction can be at the ligament of Treitz, so that the duodenum would appear dilated. We have had almost no experience with this lesion at The Children's Hospital of Philadelphia, but it should certainly be included in our thinking when we encounter obstructive lesions of the duodenum.

TREATMENT

The treatment of annular pancreas is, of course, in the realm of the surgeon, but there are several points which need emphasizing. At the present time the majority of surgeons seem to favor a by-passing procedure. Gross (3, 12) believes a duodenojejunostomy is the ideal type of surgical correction. There is a definite tendency, when the anomaly is met for the first time, simply to section the anterior ring. This was the procedure carried out in our Cases I and II when they were first discovered, but in each instance there was such a degree of stenosis due to underlying fibrosis of the bowel that the obstruction was not relieved. Our other cases also showed a high degree of stenosis or atresia in the region of the annulus, and in a review of the literature this is found to be a common observation. Simply cutting the anterior segment of the ring is therefore not going to help the obstruction. Another argument against this procedure is the danger of cutting either the pancreatic duct or the common bile duct. In some cases the annulus is so deeply embedded in the duodenal wall that to section the annulus one must almost enter the duodenum.

As radiologists we should be prepared to advise a by-passing operation whenever the diagnosis is suspected. In our Case VIII the duodenum beneath the duodenal band was stenotic as a result of intrinsic fibrosis of the bowel wall. It was not until a by-passing operation was done that the obstruction was relieved. We emphasize this because recently a case was seen at another hospital of a simple duodenal band. The band was cut, but the obstruction was not relieved. Following a second operation to by-pass the part of the duodenum over which the band had passed, the child became asymptomatic. No one was very certain as to why the second operation was necessary, but our experience with annular pancreas and duodenal bands indicates that there is frequently enough fibrosis of the bowel wall to prevent the duodenum from dilating to normal after section of the band. This fact should be known to radiologists.

SUMMARY

Eight cases of annular pancreas have been presented: 1 in an adult and 7 in the neonatal period. The seven infants were seen in a little less than two years time. These 8 cases demonstrate the variable degree of obstruction produced by this anomaly, varying from complete atresia to no obstruction at all. Because of the variable degree of obstruction, the roentgen findings are not always diagnostic. It is felt, however, that they are sufficiently suggestive in most instances to lead to a presumptive diagnosis. It has been shown, also, how to differentiate this condition from duodenal atresia, duodenal bands, volvulus of the duodenum, and duodenal webs. The treatment has been discussed to acquaint radiologists with the various surgical methods of relieving the obstruction. Because we have seen these 8 cases in less than three years time, it is our belief that the anomaly is not as rare as it is thought to be.

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SUMARIO

Oclusión Duodenal Debida a Páncreas Anular, con el Diagnóstico Diferencial de Otras Lesiones Congénitas que Producen Oclusión Duodenal

Un repaso de la literatura reveló unos 85 casos de páncreas anular, 48 de los cuales habían sido tratados quirúrgicamente. Veintiuno de los casos quirúrgicos fueron en lactantes.

Preséntanse aquí 8 casos: 1 en un adulto y 7 en lactantes, con referencia particular a los hallazgos roentgenológicos. Los 7 niños fueron observados en un período de dos años. Seis de este grupo fueron operados. En el caso restante, la anomalía constituyó un hallazgo fortuito en la autopsia.

La intensidad de la oclusión producida por el páncreas anular varía de caso en caso, por lo cual no hay ningún signo roentgenológico aislado en que pueda confiarse. No obstante, hay varios aspectos indicativos. Puede observarse una estenosis lisa concéntrica en la segunda porción del duodeno con dilatación proximal a la zona estrechada. Otro hallazgo importante es la dilatación e inflación con aire del estómago y del capuchón duodenal, con falta de aire en la segunda porción descendente del duodeno, y burbujas de aire en la tercera porción. A este último cuadro, los AA. denominan "signo de la doble burbuja."

Los estados que hay que diferenciar son la oclusión debida a bridas duodenales, el vólvulo del duodeno cuando existe malrotación total del intestino, la atresia duodenal, la presencia de una membrana a través de la luz del duodeno y la hernia paraduodenal.

Está indicada una operación desviadora. La mera resección del anillo de tejido constrictor es inadecuada y puede resultar peligrosa.

DISCUSSION

David S. Carroll, M.D. (Memphis, Tenn.): First, I would like to congratulate Dr. Hope and Dr. Gibbons upon their excellent presentation of an important anomaly. There is obviously little that I can add. We have seen 5 cases of congenital annular pancreas in which we had an opportunity to examine the patient radiologically and in which surgery later demonstrated the

annular pancreas as the cause of duodenal obstruction. Four of our patients were two weeks of age or younger; one was eighteen months old. All 5 of these cases were seen in a general hospital in which about 95 per cent of the gastrointestinal studies are on adults and only 5 per cent on children. This is certainly in contradistinction to the literature, which shows more cases in adults than in infancy.

In two respects our experience is somewhat different from that of Dr. Hope and Dr. Gibbons. In 4 of our cases the congenital annular pancreas was the only anomaly found. In the fifth instance there was an associated malrotation of the colon with a congenital band across the third portion of the duodenum.

The other difference lies in the absence from our series of any instance of complete obstruction due to the anomaly. The obstruction was rather high-grade in all instances but invariably some gas was found beyond the point of occlusion.

The three features that have been most helpful to us in making the diagnosis are: (1) the rather marked distention of the duodenal cap; (2) the location and appearance of the obstructing lesion; (3) the fact that the obstruction is not complete. We have been able to make the diagnosis in three instances and in retrospect should have suggested it in all of the cases. The diagnosis is obviously much more difficult if the obstruction is complete or if it is very minimal.

I believe that it is important that the surgeon be warned in advance that he may be dealing with a congenital annular pancreas because it is certainly important that he does not try to cut across the pancreatic tissue. Our surgeons believe that the treatment of choice is duodenojejunostomy. Two of our patients died postoperatively; 3 are living and well at the present time.

One question is most puzzling. We have seen almost as many cases of congenital annular pancreas in the past three years as we have cases of hypertrophic pyloric stenosis. The anomaly obviously has occurred in the past and is not increasing in frequency. Why have we not seen such cases before?

Frederic N. Silverman, M.D. (Cincinnati, Ohio): I should like to congratulate the authors on this very excellent paper, a very timely one. In Cincinnati we have not had any experience at Children's Hospital with annular pancreas. I hope we are not missing such cases radiologically; we shall look for them much more frequently in the future.

I should like to ask Dr. Hope if he will clarify his concept of how annular pancreas produces atresia. I believe he stated that atresia in at least one of the cases was the result of an annular pancreas. Most of us have accepted the view of Bremer that atresia of the bowel results from a failure of recanalization during the rapid changes which take place between the fifth and eighth weeks of fetal life.

It would appear to me that the association of atresia with annular pancreas is comparable to its association with malrotation, namely another malformation occurring at the same time.

W. Kelley Hale, M.D. (Wilmington, Ohio): Dr. Carroll in his discussion mentioned the fact of congenital pyloric obstruction. At Children's Hospital in Cincinnati twenty-five or twenty-six years ago I operated in a typical case of congenital pyloric stenosis. The baby died about two days later and postmortem we removed a typical pyloric obstruction.

In my own hospital, where the pathologist made serial sections of this pylorus, we found in a number of sections a triangular piece of material, gland, toward the posterior side, near the edge, having no association with the mucous membrane on the inside. At first I thought we might be dealing with a Brunner's gland, but more careful examination convinced me of the presence of islands of Langerhans and I published a report of the case in the *Annals of Surgery*, in 1926, I believe it was.[1]

Shortly afterward, Dr. Walter Simpson, in a review of the literature on accessory pancreatic tissue,[2] stated that he had never found a similar case. I also made a careful search of the literature in the Cincinnati General Hospital library and could find no other instance. There are, however, a number of cases of pyloric obstruction in adults in which accessory pancreatic tissue has been reported, and it occurred to me that this might be a possible cause of congenital pyloric obstruction.

Dr. Arthur S. Warthin, the famous pathologist at Ann Arbor, abstracted my paper for *Clinical Medicine*. Dr. Zimmerman, Professor of Anatomy at the University of Illinois, questioned the diagnosis of accessory pancreatic tissue, and thought that it was a Brunner's gland, though finally they made me feel that it was actually a case of accessory pancreas.

The secretion put out by this pancreatic tissue in the pylorus sets up a reaction increasing the size of the pylorus. Recently I had a letter from a pathologist at Children's Hospital in Cincinnati, written from Vermont, where he had seen a child with symptoms of congenital pyloric stenosis. A pancreas was found, but no signs of typical congenital pyloric stenosis. When I get home I've got to confront this pathologist with my sections. I looked over these the other day and they still looked like pancreatic tissue to me. I could find no evidence of Brunner's gland. I would recommend, therefore, as I have in the past, that in cases of pathological pyloric stenosis serial sections be made to see if there is any accessory pancreatic tissue.

[1] Ann. Surg. **83**: 774, June 1926.
[2] Warthin Annual Volume, 1927, pp. 435–459.

John W. Hope, M.D. (*closing*): I wanted to emphasize the surgical treatment of this lesion, but time did not permit. You recall our first two cases. In each instance the surgeon was confronted for the first time with such a lesion, and he did the obvious thing—he cut the anterior ring of the pancreas. This is the one thing which should not be done. Often the pancreatic duct has been cut accidentally, with subsequent fistula, pancreatitis, and death. Occasionally the common bile duct has been cut, resulting in fistula and death. Sometimes when the surgeon tries to dissect the anterior ring free of the bowel, the duodenum is opened because the two are in such close approximation. Finally, as most of our cases illustrate, the stenosis persists even after the encircling ring has been cut. The proper surgical approach is the shortest short-circuit anastomosis possible, either a duodeno-duodenostomy or a duodenojejunostomy.

Dr. Carroll spoke of having seen as many cases of annular pancreas as of hypertrophic pyloric stenosis. This is also our experience. We are asked to examine suspected cases of hypertrophic pyloric stenosis only when the tumor cannot be palpated and this is relatively unusual when there is a large medical and surgical house staff. As a result, we have few cases of hypertrophic pyloric stenosis to examine.

I cannot answer Dr. Silverman's question about the relationship between duodenal atresia and annular pancreas, although I suppose it is based on the fact that the encirclement was so tight that recanalization just did not take place.

In answer to the third comment, ectopic pancreas has been described many times. In reviewing the literature for this paper, reports were frequently found of ectopic pancreas in the wall of the duodenum and in the stomach.

Sprue vs. Pancreatogenous Steatorrhea

An Evaluation of the Small Bowel Study as an Aid in Differentiation[1]

AUBREY T. HORNSBY, M.D., and GEORGE J. BAYLIN, M.D.

THE CLINICAL AND laboratory differentiation of the various causes of steatorrhea is often difficult. Recently interest has been aroused in the possibility of distinguishing sprue from pancreatogenous steatorrhea by roentgen examination. Numerous reports on this subject have appeared in the past two decades.

Snell in 1939 (1) stated that it was not possible to make a distinction between these two conditions. Weber and Kirklin (2) are equally firm in their conclusion that the small bowel pattern of sprue cannot be distinguished from that of pancreatogenous steatorrhea. This might be said to represent the majority opinion today. Bjerkelund and Husebye (1950), on the contrary, believe that there are characteristics in the small bowel pattern that permit this differentiation (3). Weigen, Pendergrass, Ravdin, and Machella, in two experimental studies on dogs in 1952 (4) and 1953 (5), reinforced the affirmative side of the argument. These workers in the first of their studies extirpated the pancreas, and in the second ligated the pancreatic duct. They demonstrated that the two procedures did not alter the small bowel pattern in the dog. Golden (6), in 1941 wrote: "As far as can be determined now, the presence or absence of pancreatic enzymes makes no difference in the small intestinal pattern."

The published experience of the last two decades reveals two leading causes for steatorrhea. These are sprue and pancreatic intestinal enzyme deficiency. Three basic classifications of steatorrhea are generally accepted:

(*a*) *Idiopathic*, as seen in sprue and severe deficiency states.

(*b*) *Pancreatogenous*, resulting from a deficiency of pancreatic intestinal enzyme. Intrinsic inflammatory or neoplastic disease, duct obstruction, and extirpative surgery are the chief causes.

(*c*) *Symptomatic*, the result of obstruction of small bowel lacteals by neoplastic or inflammatory processes. This is a heterogeneous group, including amyloid disease, lymphoma, Whipple's disease, regional enteritis, and others.

Reference to these classifications is found in two symposia by Ricketts, Maimon and Knowlton (7), and Durant and Zibold (8). Bjerkelund and Husebye (3), and Pearson (9) have also contributed. The present report will be concerned only with the idiopathic and pancreatogenous types, and will pertain only to the small bowel pattern of adults. Zwerling and Nelson (10) have demonstrated the inconstancy of this pattern in the normal pediatric group.

MATERIAL

This report is based upon small bowel studies in 19 cases of sprue, compared with those in 10 cases of pancreatogenous steatorrhea. These cases were seen on the Medical and Surgical Services of Duke Hospital during the last twenty-three years.

Two basic criteria were used in the selection of the sprue cases: (*a*) The patient must not have received specific antisprue therapy (liver or extensive multivitamin supplement) prior to the small bowel study analyzed, or (*b*) if such therapy were given, it must not have been clinically effective. It is well recognized that liver therapy can cause an abnormal small bowel pattern due to sprue to revert toward a normal pattern. The clinical follow-up and response to specific therapy in the 19 cases have been maintained for a sufficiently long period to confirm the diagnosis.

[1] From Duke University, School of Medicine, Department of Radiology, Durham, N. C. Accepted for publication in September 1953.

TABLE I: SMALL BOWEL CHARACTERISTICS IN 19 CASES OF SPRUE

Small Bowel Characteristics	Cases																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Moulage sign. Sausage-like dilatations (barium-filled)	+	±	+	+	+	0	+	+	+	0	+	+	+	0	+	+	+	+	+
	+		+	+	+		+	+	+		+	+	+		+	+	+	+	+
	+						+		+		+				+		+		
							+								+				
Dilated loops of small bowel (air-filled)	0		0			0				0		0	0					0	
		+		±	+		+	+	+		+			+	+	+	+		+
		+			+		+	+						+	+	+			+
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Coarse folds	+	+	+	+	+	+	+	+	+	±	+	+	+	+	+	+	+	+	+
	+		+	+	+		+	+	+		+	+	+	+	+		+	+	+
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Flocculation						0	0			0									
	+	+	±	+	+			+	+		+	+	+	+	+	+	+	+	+
	+							+	+			+			+			+	+
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Transit time (hours)	6	3	6	3	5	5	?	6	3	4	4	3	5	4	3	2	5	6	2

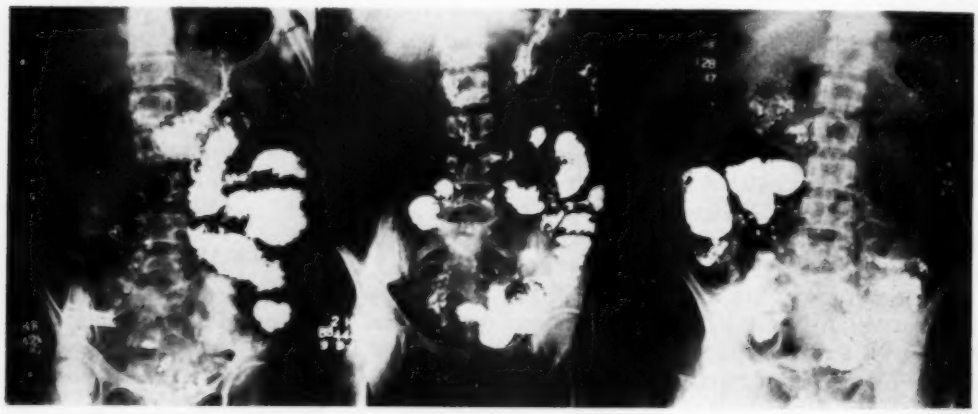

Fig. 1. Small bowel study in active sprue (Case 15) illustrating typical moulage signs.

In the 10 cases of pancreatogenous steatorrhea, the diagnosis was made by exploratory laparotomy in 7 cases and calcification of the pancreas in 3 cases. A further breakdown of these 10 cases is as follows: (*a*) Three patients (Cases 22, 24, and 25) had carcinoma of the pancreas or common bile duct confirmed by laparotomy. In 1 the head of the pancreas was removed at surgery.

(*b*) Three patients (Cases 20, 21, and 23) had all, or a considerable part, of the pancreas removed under a mistaken diagnosis of pancreatic carcinoma or carcinoma in a contiguous structure extending to the pancreas. One of this group (Case 23) underwent a complete pancreatectomy. Steatorrhea was a postoperative complication in each instance. In this group, the effect of plastic procedures on the stomach, duodenum and/or jejunum must be taken into account in evaluating the small bowel pattern.

(*c*) Four patients (Cases 26, 27, 28, and 29) had chronic relapsing pancreatitis. This was confirmed by laparotomy in 1 case (Case 29). In the other 3, moderate to marked degrees of pancreatic calcification were present to substantiate clinical evidence of the condition.

It is to be emphasized that in all 29 cases steatorrhea was present at the time of evaluation of the small bowel study. The evidence for this statement rests on the

TABLE II: SMALL BOWEL CHARACTERISTICS IN 10 CASES OF PANCREATOGENOUS STEATORRHEA

Small Bowel Characteristics	Cases									
	20	21	22	23	24	25	26	27	28	29
Moulage sign. Sausage-like dilatations (barium-filled)	0	0	0	0	0	±	0	±	0	0
Dilated loops of small bowel (air-filled)	0	±	0	0	0	0	0	0	0	0
Coarse folds	0	+	0	+	+	±	0	±	±	0
Flocculation	0	+	+	+	+	0	0	+	+	+
Transit time (hours)	7	6	3	6	1	2	6	4	6	4

following data: (*a*) All 29 cases had excess stool fat as shown by the history, visual observation of stool specimen, and Sudan III stain. (*b*) Twelve of the 29 cases had 72-hour fat-balance studies, with subnormal absorption. In 11 additional cases, excess fat was demonstrated by assay of a 24-hour dried stool specimen. (*c*) Twenty-eight patients had an abnormal vitamin A level or tolerance curve.

METHOD OF SMALL BOWEL STUDY

Approximately 200 c.c. of a half-water, half-barium mixture was administered orally. The rate of passage of the barium column was estimated under fluoroscopic examination, while the stomach and duodenum were being surveyed. Abdominal films, usually at hourly intervals, were obtained until the barium column reached the cecum. Fluoroscopy of the barium column was performed where indicated from the films and clinical data.

RESULTS

The small bowel pattern characteristics of sprue are presented in Table I, and the characteristics in the pancreatogenous steatorrhea group in Table II. The "moulage sign" of these tables is as described by Kantor (11).

A substantial qualitative difference in the small bowel pattern resulting from the active phases or sprue and pancreatogenous steatorrhea is clearly revealed. What are the absolute and relative differences manifested by this analysis?

Absolute Differences: Three of the sprue cases demonstrated sufficient generalized atony, *i.e.*, dilated gas-filled loops of small bowel, to simulate a paralytic ileus. An upright film of the abdomen in one instance (Fig. 2D), clearly demonstrated fluid levels. Kantor (11) in 1939, Golden (6) in 1941, and Glass (12) in 1948 made similar observations. Nothing resembling this was found in any case of pancreatogenous steatorrhea.

Relative Differences: (*a*) The moulage sign of Kantor (11) must be put in this group. The frequency of its presence in the sprue cases and its absence in the pancreatogenous steatorrhea group deserve emphasis. The moulage was unmistakably present in 15 of the 19 sprue cases, equivocal in 1, and absent in 3. It was unequivocably absent in 8 of the 10 ileal studies of pancreatogenous steatorrhea, equivocal in 2, and *definitely present in none.*

(*b*) The other characteristics tabulated, coarse folds and flocculation, were on the whole more frequent and pronounced in patients with sprue than in those with pancreatogenous steatorrhea.

No Difference: The *transit time* varied between one and seven hours in all 29 cases. Neither group showed any striking delay or rapidity.

In summary, about one-half of the pancreatogenous steatorrhea group could be accepted as normal or manifesting minor variations of the normal. The other half might be included in the minimal disordered motor function group as commonly accepted today. Four of the 19 sprue

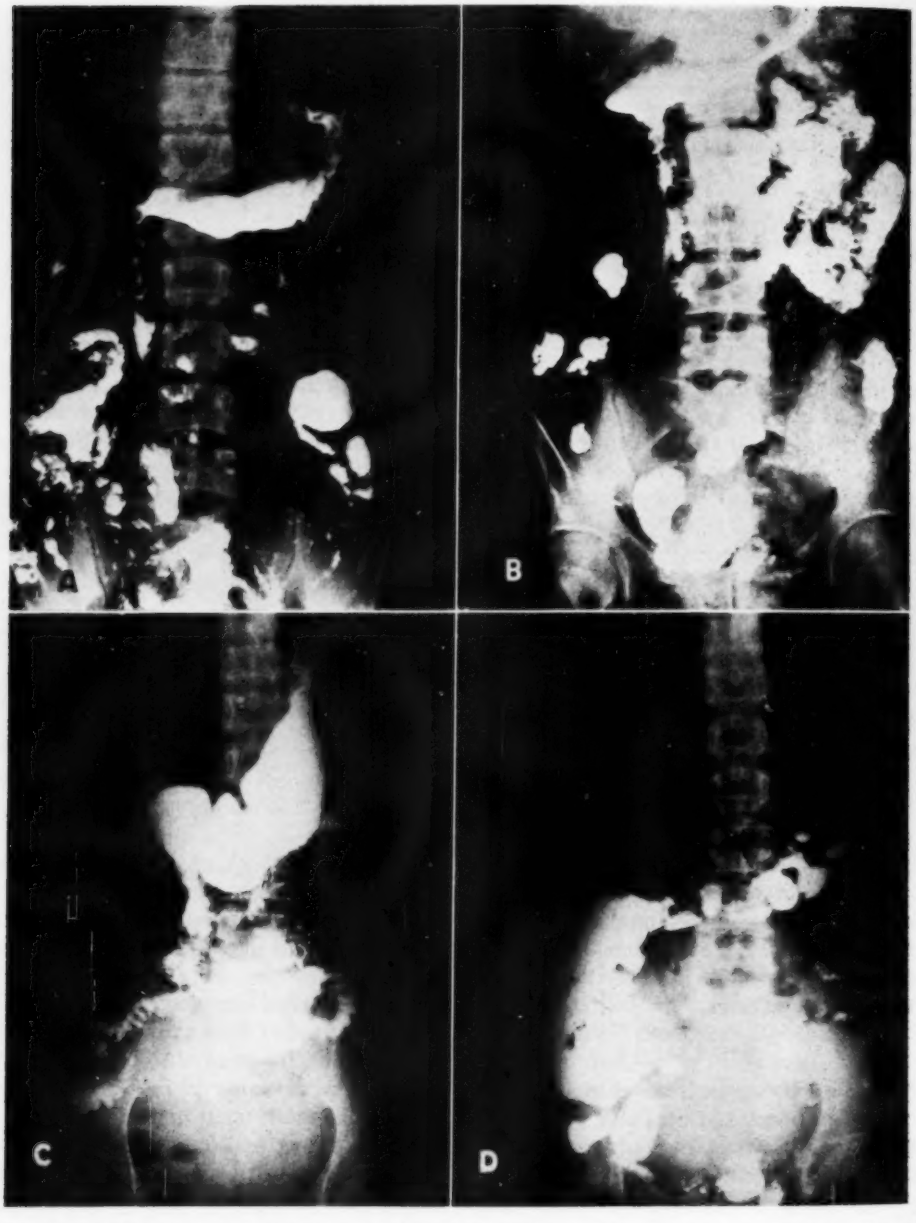

Fig. 2. Small bowel study in active sprue (Case 19) illustrating typical moulage signs. Fluid levels are seen in the upright film (D).

cases could be readily confused with the pancreatogenous group on the basis of relative "normality." The other 15 were easily distinguishable from pancreatogenous steatorrhea.

DISCUSSION

The data as presented demonstrate conclusively that the small bowel patterns in sprue and pancreatogenous steatorrhea, considered as groups, differ materially.

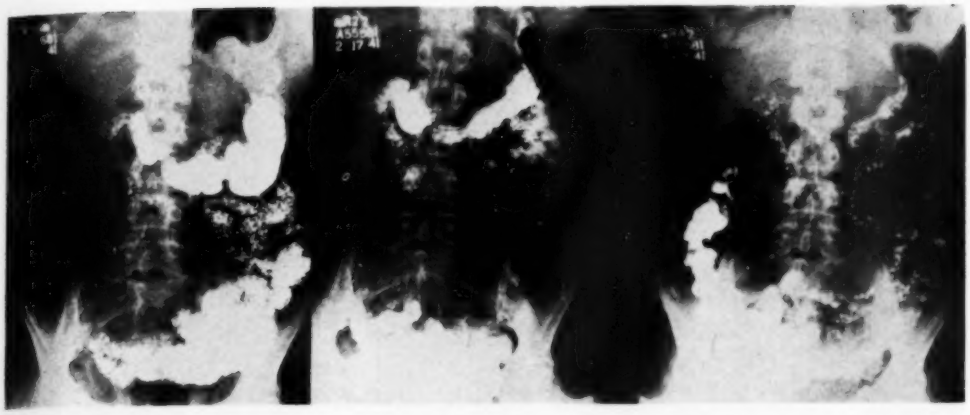

Fig. 3. Small bowel study showing a normal pattern in a well documented case of active sprue (Case 10).

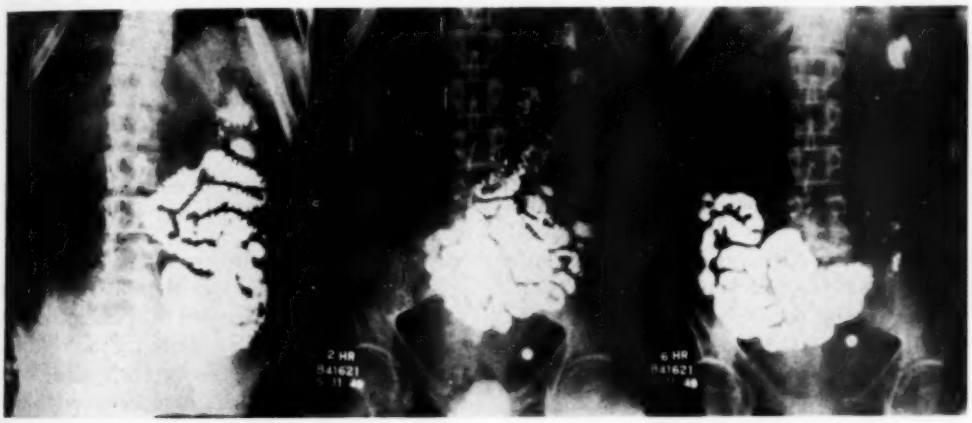

Fig. 4. Small bowel study in a case of pancreatogenous steatorrhea following subtotal pancreatectomy (Case 21). The study shows a coarse fold pattern, but considered to be within normal limits.

The small bowel pattern in pancreatogenous steatorrhea approaches or coincides with the "normal" pattern. The many variations seen in the "normal" small bowel pattern are well described in a previous article (Baylin *et al.*, 13). In that study 13 controls were hospitalized and thoroughly examined to establish their historical and physical "normalcy." Only 8 of the 13 had the typical "normal" small bowel pattern during the period of observation. It would be wise for the roentgenologist to set up rigid criteria only for the abnormal. The normal covers a wide range indeed.

The application of the observations of the present report *to the individual* patient, however, as a basis for differentiation, is fraught with at least two formidable hazards:

(*a*) In a certain percentage of active sprue cases the small bowel study will be within the normal range (see Fig. 3). Suarez *et al.* (14) state that 30 per cent of their sprue small bowel studies did not reveal a typical severe deficiency-state pattern. Snell reported two negative small bowel studies in 25 active—and presumably not extensively treated—cases of sprue, *i.e.*, 8 per cent. This latter experience more closely resembles that of the present writers.

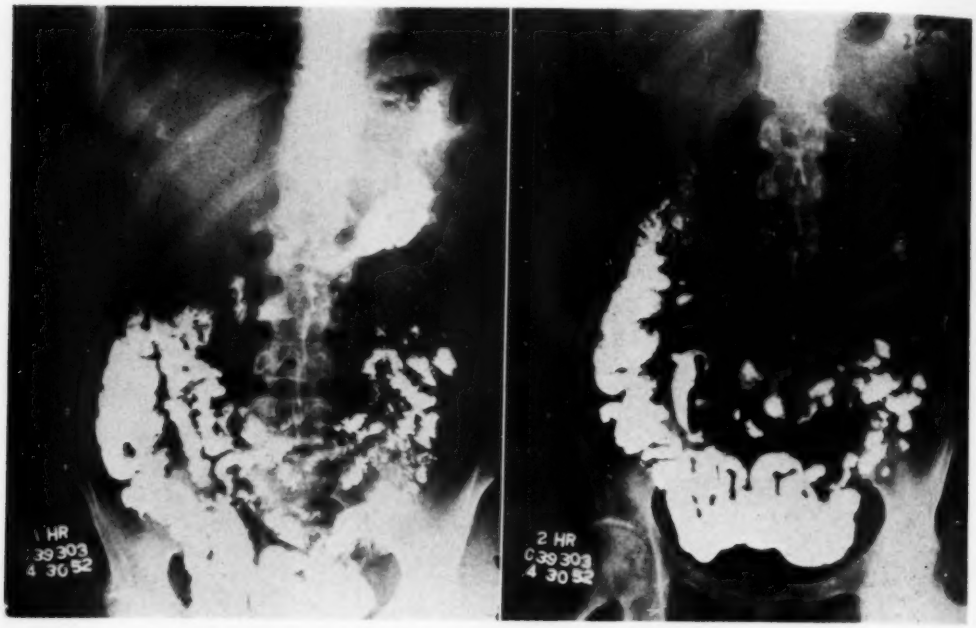

Fig. 5. Small bowel study in a case of pancreatogenous steatorrhea due to primary carcinoma of the pancreas, confirmed at laparotomy (Case 24). Coarse fold pattern.

(*b*) Pancreatogenous steatorrhea can result in a severe deficiency state. Why it is so rarely the cause of a severe deficiency small bowel pattern, as reported by Bjerkelund and Husebye (3) and observed in our experience, is not known.

In spite of much expressed opinion, the basic cause of neither flocculation nor the moulage sign has been adequately revealed. Steatorrhea can exist without either of these characteristics. Thus, we believe that a high percentage of fat in the small bowel contents can only be partially responsible for them, if indeed it is responsible to any degree.

Kirsh and Spellberg (15) in a recent article tend to implicate the ready flocculation of the commonly used barium-water suspension as a source of many of the changes in the small bowel pattern of sprue and the severe deficiency states. The work of Frazer, French, and Thompson on *in vivo* and *in vitro* flocculation (16) is drawn upon in support of this opinion, and it undoubtedly has some validity. It is to be emphasized, however, that evidence of small bowel abnormality resembling paralytic ileus can be demonstrated on plain films in severe cases of sprue, without use of a contrast medium of any kind. We believe the moulage sign is in some way a reflection of this change seen on plain films. The significance of flocculation remains an enigma.

SUMMARY

(1) The small bowel pattern in active sprue, as a group, differs from that in pancreatogenous steatorrhea.

(2) With stated reservations, these differences may be used in the individual case as an aid in differentiating sprue from pancreatogenous steatorrhea.

(3) As a general axiom, the closer the small bowel pattern approaches the normal, the more likely it is that the steatorrhea is of pancreatogenous origin.

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SUMARIO

Espruo y Esteatorrea Pancreatógena: Justipreciación del Estudio del Intestino Delgado como Auxiliar en la Diferenciación

Los estudios roentgenológicos del intestino delgado en 19 casos de esprúo fueron comparados con estudios semejantes en 10 casos de esteatorrea pancreatógena. En los 29 casos, había esteatorrea al hacerse los estudios, según se determinó por medio de adecuadas observaciones clínicas y de laboratorio.

Notóse una notable diferencia cualitativa en el patrón del intestino delgado entre los dos estados, considerados en conjunto, aunque esto no reza siempre con un caso dado. Hubo atonía generalizada, traducida por dilatación e inflación con gas de asas intestinales en 3 casos de esprúo, sin que se observara esto en ninguno de los casos de esteatorrea pancreatógena. En todos los casos de esprúo, menos 3, existía indudable o problemáticamente el llamado signo del "moulage" de Kantor. Faltaba el mismo indudablemente en 8 casos del grupo pancreatógeno y no existía ciertamente en ninguno. Los pliegues groseros y la floculación eran más frecuentes en los psilóticos.

Dedúcese que, en general, mientras más se aproxime el patrón intestinal a lo normal, más probable es que la esteatorrea reconozca origen pancreático.

Some Pulmonary Changes Associated with Intracardiac Septal Defects in Infancy[1]

KENNETH L. KRABBENHOFT, M.D., and WILLIAM A. EVANS, JR., M.D.

AT THE CHILDREN'S HOSPITAL of Michigan a collection has been made of roentgenograms of the chest of infants and children dying from congenital cardiovascular malformations, on whom a careful postmortem examination has been performed. In reviewing groups of these cases in an effort to find more accurate criteria for antemortem diagnosis, a high incidence of atelectasis and emphysema in the lungs was observed in the group with interatrial septal defects. Our purpose here is to study this observation in detail and to test its validity by examining other comparable groups of cardiovascular abnormalities for similar manifestations.

MATERIAL

The material consists of 7 cases of interatrial septal defect, 10 cases of combined interatrial and interventricular septal defects, 9 cases of interventricular septal defect, and a control group of 18 cases of transposition of the great vessels. The septal defects are listed below, indicating the various types encountered and the number of each.

Group I.	Interatrial septal defect	7
	1. Patent foramen ovale	5
	2. Persistent ostium primum	2
Group II.	Interatrial and interventricular septal defects	10
	1. Patent foramen ovale with a high interventricular septal defect	6
	2. Persistent atrioventricularis communis	4
Group III.	Interventricular defect	9

Table I gives the relative incidence of pulmonary atelectasis and/or emphysema in these various groups as compared with the control group, in which the principal cardiac malformation was a transposition of the great vessels. It is evident that there is a high incidence of pulmonary atelectasis and emphysema in infants dying with intracardiac septal defects, particularly with interatrial septal defects. The atelectasis tends to involve the upper lung, and the emphysema occurs predominantly in the lower lung. Eighty-six per cent of the patients with interatrial septal defects exhibited associated pulmonary atelectasis and/or emphysema, while those with combined interatrial and interventricular defects showed an incidence of 50 per cent. Twenty-two per cent of the patients with isolated interventricular lesions had such pulmonary changes. In only 1, or 5.5 per cent, of 18 patients constituting the control group with transposition of the great vessels did recognizable emphysema develop.

It would seem that the frequent occurrence of atelectasis and emphysema with congenital septal defects should be of some diagnostic significance. Taussig (15) has stated that pulmonary infections occur with sufficient frequency in patients with septal defects to be of diagnostic aid. Furthermore, the fatal outcome of the cases presented in this study imparts prognostic significance to these changes.

Do these manifestations represent a basic structural abnormality of the bronchi or lungs which predisposes to respiratory infection? Does the disturbance of the pulmonary circulation (dilatation of the pulmonary artery and capillaries) associated with the septal defect produce an inadequate pulmonary function which predisposes to infection, emphysema, and atelectasis? Are these infants otherwise peculiarly susceptible to respiratory infections which result in these pulmonary changes? The evidence at hand does not provide a decisive answer to these questions, but we are inclined to the view that in association with the interatrial septal

[1] From the Children's Hospital of Michigan, Detroit, Mich. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.

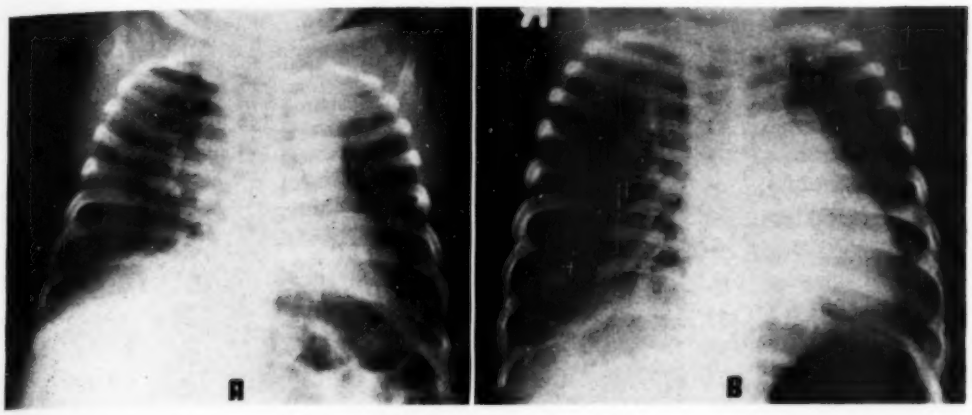

Fig. 1. Case I. A. Roentgenogram at three months of age, showing widening of superior mediastinal shadow due to left upper lobe atelectasis. B. Roentgenogram at seven months of age, one day before death, showing marked emphysema of the right mid-lung field and atelectasis of the right upper lobe. The left upper lobe was also thought to be emphysematous, with segmental atelectasis.

TABLE I: INCIDENCE OF PULMONARY CHANGES IN PATIENTS WITH SEPTAL DEFECTS AND CONTROLS

Septal Defects	No. of Cases	Pulmonary Changes	Control Group	No. of Cases	Pulmonary Changes
Interatrial	7	6(86%)	Transposition of great vessels	18	1(5.5%)
Interatrial and interventricular (combined)	10	5(50%)			
Interventricular	9	2(22%)			
TOTAL	26	13(50%)	TOTAL	18	1(5.5%)

defect, and to a lesser extent with other types of defects, there is often an abnormal anatomical structure of the lung (bronchial cartilage, respiratory epithelium, or glandular function) which predisposes to persistent and recurrent respiratory infection, emphysema, and atelectasis.

CASE REPORTS

Interatrial Septal Defect

CASE I: Y. B., a colored female infant, was first seen in the Out Patient Clinic at the age of three months with a history of difficult breathing since birth, fever, and a mucoid nasal discharge. Antibiotics and symptomatic measures were prescribed. During the following month the child had frequent colds and increasingly severe dyspnea. Retraction of the chest was noted, but the heart was not thought to be abnormal clinically. A chest roentgenogram at this time revealed widening of the superior mediastinal shadow (Fig. 1A). An enlarged thymus, abnormal vascular structures, or atelectasis of the left upper lobe were suggested.

At further visits during the next four months respiratory difficulty continued, but the child made rapid weight gains. A series of roentgen treatments over the thymus was without apparent benefit.

A respiratory infection, with excessive mucus in the pharynx, fever, and vomiting, led to hospital admission at seven months of age. Physical examination revealed coarse râles and retraction of the chest. Slight cyanosis was noted for the first time. Gradual improvement was observed, and the patient was discharged to her home on the sixth hospital day, only to be readmitted one week later, because of high fever, severe dyspnea, and retraction, developing suddenly in the previous twenty-four hours. Roentgen study of the chest at this time (Fig. 1B) revealed marked emphysema and segmental atelectasis, which had appeared in the past month. These changes were attributed to partial and complete bronchial obstruction. Fibrocystic disease of the pancreas was also considered, due to the long duration of the illness.

In the hospital the child became progressively more dyspneic and died in "sudden" respiratory failure, at the age of seven months and twenty days.

At *autopsy*, the right upper and lower lobes were atelectatic, and the right middle lobe was emphysematous. The lingula also exhibited emphysema. A patent foramen ovale with a small degree of cardiac enlargement, principally due to dilatation of the right atrium and ventricle, was observed.

Microscopically, there was extensive chronic interstitial pneumonitis with mononuclear and giant cells in the alveolar spaces. Acidophilic cytoplasmic

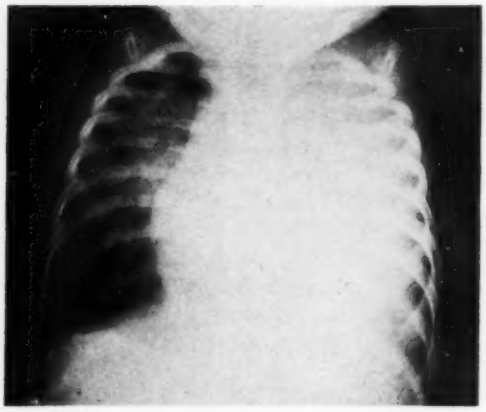

Fig. 2. Case II. Roentgenogram at seven months of age, showing atelectasis and consolidation of the left lung with extensive infiltration in the right lung. Child expired on same day.

inclusion bodies were observed in the bronchiolar epithelium.

Comment: The history and clinical course in this case are typical for the group. This cardiac abnormality should be compatible with a reasonably normal life, but the superimposition of repeated respiratory infections, which the patient could not tolerate, led to her death.

CASE II: E. J., a colored female infant, was admitted to the hospital with irritability, cough, and nasal discharge of one week duration. She was acutely ill, with grunting respirations, fever, and retraction of the chest on inspiration. Dullness to percussion and bronchial breath sounds were heard over the left hemithorax. No abnormality was noted on the right side. A loud systolic murmur was heard over the apex, and the heart was enlarged. There was slight enlargement of the liver.

Three attempts were made to perform a thoracentesis, without obtaining fluid. A chest roentgenogram at this time revealed a left pneumothorax but no free fluid. The heart was enlarged, particularly in the region of the pulmonary conus. There was dense hilar infiltration in the right lung.

Antibiotics and oxygen were given, after which the temperature returned to normal. On the third day, a chest roentgenogram (Fig. 2) revealed reabsorption of the pneumothorax, with apparent atelectasis of the left lung and further infiltration of the right lung.

The child expired on the same day at seven months and twenty days of age.

At *autopsy*, diffuse bronchopneumonia involved both lungs and there was partial collapse of the left lung. A widely patent foramen ovale with enlargement of the heart, particularly hypertrophy of the right ventricle, was observed. The pulmonary conus was enlarged and the pulmonary artery was dilated. As an incidental finding, there was an aberrant retro-esophageal right subclavian artery.

Microscopically, the bronchial mucosa was ulcerated and the small bronchi were filled with mucus.

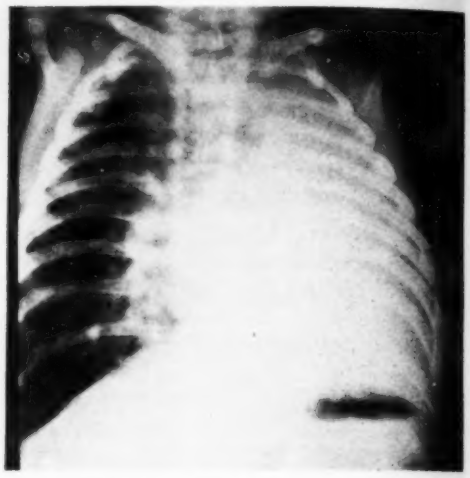

Fig. 3. Case III. Roentgenogram at five months of age, showing massive atelectasis of the left lung.

There was evidence of pulmonary and hepatic vascular congestion.

Comment: The extensive bronchopneumonia was considered to be the chief cause of death in this patient, inasmuch as the cardiac malformation in itself would ordinarily be compatible with a reasonably normal life expectancy. The presence of excessive mucus in the bronchi is of some interest.

The average age at death in this group of patients with isolated interatrial septal defect was 10.9 months. The oldest was three years and nine months and the youngest was twenty-one days of age. The remaining 5 patients ranged from four to seven months of age at the time of death. All of these infants were brought for medical attention initially because of respiratory infection. The incidence of accompanying pulmonary emphysema and atelectasis was highest in this group (86 per cent). One of the patients was a mongolian idiot.

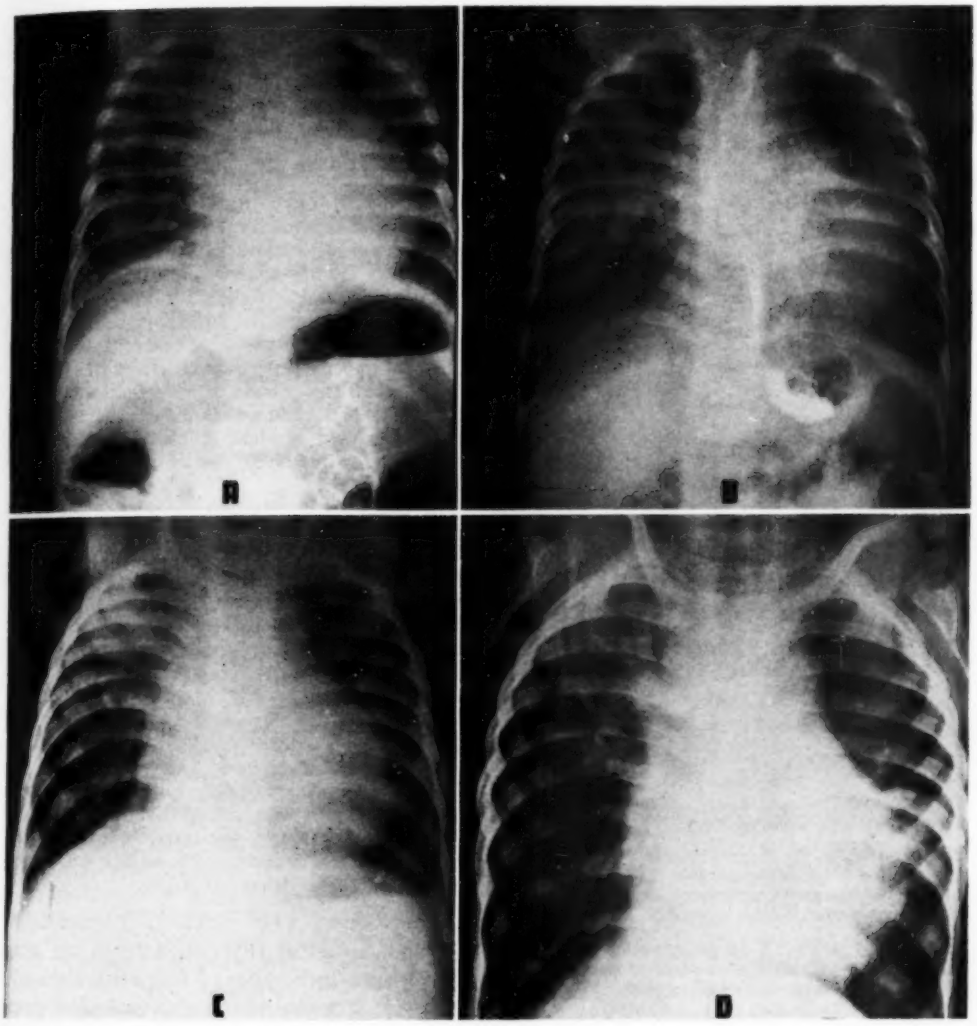

Fig. 4. Case IV. A. Roentgenogram at three months of age, showing infiltration of the right upper lobe, emphysema of the right lower and left lung fields, and cardiac enlargement. B. At six months of age. The right upper lobe infiltration has resolved, and there is now middle lobe infiltration. C. At seven months. The middle lobe has cleared, and infiltration is again evident in the right upper lobe. D. At one and a half years of age. The right upper lobe process continues and there is now marked emphysema. The heart is still enlarged.

Combined Interatrial and Interventricular Septal Defects

CASE III:[2] J. C., a white male infant, was admitted to the hospital, having had a cough and dyspnea since birth. He exhibited signs of a congenital heart abnormality and had been hospitalized repeatedly elsewhere. Examination on admission revealed a loud systolic murmur and thrill, complete dullness over the left hemithorax, and roentgen evidence of atelectasis of the left lung (Fig. 3). Agenesis of the left lung or a vascular malformation were considered as a possible cause for the atelectasis.

Bronchoscopy revealed collapse of the left main bronchus, presumably from external pressure. There was no foreign material seen and no air exchange was apparent. The child expired two days later at five months of age.

At *autopsy*, the heart was enlarged, chiefly by

[2] This case was previously reported in a paper on bronchial malformations (5).

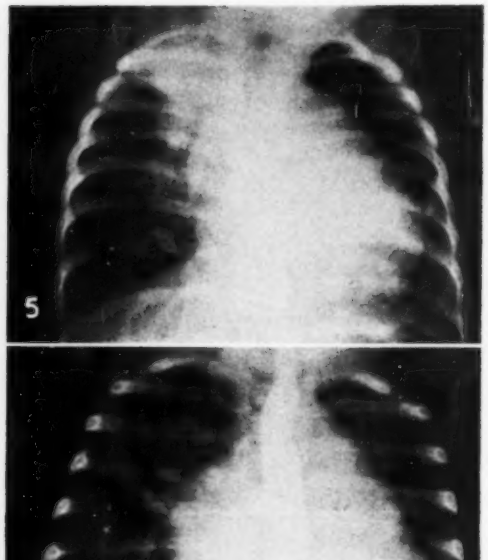

Fig. 5. Case V. Roentgenogram at four months of age, three days prior to death, showing right upper lobe atelectasis with emphysema of the right middle and lower lobes. There is marked cardiac enlargement.

Fig. 6. Case VI. Roentgenogram at three months of age, showing marked pulmonary vascular congestion and numerous emphysematous segments. The heart is enlarged and the diaphragm is depressed.

right atrial and ventricular dilatation. The left atrium, the chamber most likely to cause pressure on the bronchus, was not enlarged. A large interatrial and a high interventricular septal defect were present. There was no great vessel malformation. It is assumed that deficiency of the cartilage in the bronchial wall accounted for the collapse and atelectasis of the left lung. Unfortunately, no attempt was made to demonstrate this at autopsy.

Comment: Chondromalacia or absence of the cartilaginous rings of the bronchi has come to be recognized as a cause of pulmonary emphysema and atelectasis.

CASE IV: R. J., a colored male infant, was first admitted at three months of age with cough, dyspnea, and retraction of the chest of five days duration. There was no cyanosis. Scattered râles were heard throughout the chest, and there was a loud systolic murmur maximal at the apex. A roentgenogram at this time (Fig. 4A) revealed cardiac enlargement and low-grade infiltration of the right upper lung with emphysema. In a lateral projection there was evidence of tracheal collapsibility.

The patient improved gradually and was transferred to a convalescent home. Three months later, he had further attacks of dyspnea, cough, and wheezing. Roentgen studies now (Fig. 4B) demonstrated right middle lobe infiltration. The upper lobe process had resolved largely. One month later (Fig. 4C) the middle lobe process had cleared but the right upper lobe was again acutely involved.

The patient continued to have repeated respiratory infections, and re-examination after eleven months showed residual infiltration of the right upper lobe with definite emphysema in both lower lungs (Fig. 4D).

A cardiac catheterization was carried out subsequently at another hospital, indicating the presence of an interatrial septal defect and a possible small interventricular defect. The patient's condition remained about the same for the next six months. Finally he contracted a cold with fever and developed convulsions. The patient was dead on admittance. He was two years, two months of age at the time of death.

At *autopsy*, the lungs were emphysematous, with the bronchi and trachea filled with mucoid material. Squamous-cell metaplasia was observed in the trachea. The heart was greatly enlarged, with dilatation and hypertrophy of the right atrium and ventricle. The pulmonary artery was dilated and a large patent foramen ovale with a high interventricular septal defect was found.

Comment: The tracheal collapsibility demonstrated at three months of age may have been indicative of flaccidity throughout the tracheobronchial tree. The presence of mucoid material in the trachea and bronchi is of interest and is discussed below. Squamous-cell metaplasia of the respiratory tract epithelium may be of significance as well.

The average age at death in this group of patients with combined septal defects was 7.5 months, the oldest being two years and two months of age and the youngest one month. Six of the 10 patients were mongolian idiots, 3 of whom exhibited the frequently associated persistent atrioventricularis communis. Each of the other mongols had a patent foramen ovale with a high interventricular septal defect.

Interventricular Septal Defect

CASE V: S. M., a white female infant, was first seen with symptoms and physical findings of an upper respiratory infection and roentgen evidence of cardiac enlargement and bronchopneumonia. The pulmonary infiltration cleared to some extent, but at three months of age a well defined right upper lobe infiltration could be seen. The degree of cardiac enlargement remained quite constant. At four months of age, three days prior to death (Fig. 5), roentgen study of the chest showed a heavily consolidated atelectasis of the right upper lobe with emphysema in the remaining right lung and possibly the left lung. The child expired as a result of cardiac failure at four months of age.

At *autopsy*, an interventricular septal defect with right ventricular hypertrophy was observed. There was atelectasis of the right upper lobe and lobular atelectasis of the left upper lobe.

Microscopically, evidence of vascular engorgement was seen in the lungs.

Comment: Despite the usual absence of physiologic disturbance in the presence of an interventricular septal defect, this patient could not overcome her pneumonia and became decompensated.

CASE VI: C. M., a white female infant, was apparently well until one day prior to admission, when she began to cough and became cyanotic during the coughing episodes. There were other symptoms of a respiratory infection. A heart murmur had been detected at birth. In the postnatal period the patient had dyspnea, and became cyanotic with only mild exertion.

Examination revealed coarse, moist breath sounds with respiratory wheezes and grunts. The cardiac rate was 200–250 per minute, and a murmur was heard throughout the precordium. The heart was thought to be enlarged, and a roentgenogram (Fig. 6) revealed marked cardiac enlargement, segmental areas of emphysema, and vascular congestion. An intracardiac septal defect with a left-to-right shunt was suspected.

The patient showed a gradually rising temperature curve, with a terminal hyperpyrexia of 106° F., and expired two days after admission.

At *autopsy*, the lungs exhibited multiple hemorrhagic areas on the surface and extensive atelectatic changes. No note was made in regard to the emphysema. The heart had a high interventricular septal defect with hypertrophy and dilatation of both ventricles, more marked on the right side. There were an associated patent ductus arteriosus and endocardial sclerosis.

Microscopically, there were alveolar hemorrhagic exudate and congestion in the lungs.

The average age at death in the group of patients with isolated interventricular septal defect was 4.2 months, the oldest being eleven and a half months and the youngest seven days of age at death.

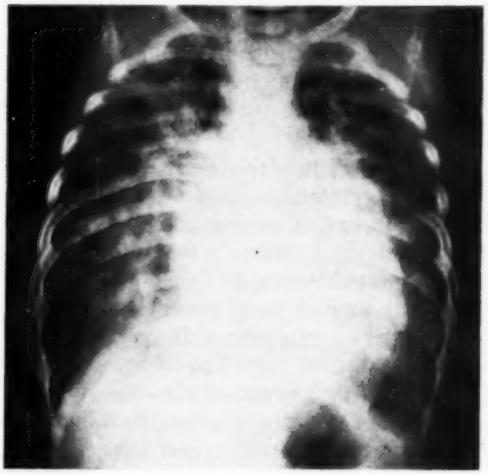

Fig. 7. Case VII. Roentgenogram at seven months of age, showing cardiac enlargement, marked vascular congestion, and bilateral emphysema. Infant expired three weeks later.

Transposition of the Great Vessels

CASE VII: R. H., a male Negro infant, was first seen at three weeks of age because of rapid respirations, and at that time a congenital heart lesion was recognized. He was admitted to the hospital at seven months of age with a respiratory infection, dyspnea, and cyanosis, of two days duration. A history of frequent colds since birth was elicited. The temperature was 104° F. Roentgen studies previously had demonstrated cardiac enlargement and vascular congestion bilaterally. Examination revealed evidence of bronchopneumonia with cardiac failure. A roentgenogram (Fig. 7) showed cardiac enlargement, marked vascular congestion, and emphysema bilaterally.

The patient's condition gradually deteriorated and he expired twenty-four days after admission at seven months, twenty-seven days of age.

At *autopsy*, extreme transposition of the great vessels with absence of the interventricular septum was found. The lungs showed bronchopneumonia, giant-cell pneumonia, congestion, and moderate emphysema.

The average age at death in the group of patients with transposition of the great vessels was 2.2 months, which is a reflection of the severity of this malformation. Perhaps it is significant, however, that the

one patient in this group in whom pulmonary complications developed was eight months of age when he expired.

CLINICAL COURSE

Respiratory infection was the precipitating incident which brought these patients for attention. Cyanosis developed after the pulmonary changes were well established, probably due to bronchial obstruction and anoxia from poor aeration. In most of these patients cardiac failure developed later, in the form of an acute cor pulmonale, as a result of elevated pressure in the lesser circuit secondary to inflammatory changes in the vascular bed and due to the increased load created by the septal defect.

The sequence of events appeared to begin with a bronchopneumonia following an upper respiratory infection. As a result of partial and complete bronchial obstruction, emphysematous and atelectatic changes occurred respectively. It would be logical to assume that the appearance of the lungs roentgenographically would vary with the duration of the disease and also with response to treatment. Patients dying early in the course of their disease would be less likely to demonstrate obvious pulmonary changes than those who have had repeated episodes of infection.

DIFFERENTIAL DIAGNOSIS

In considering these findings along with other pulmonary manifestations of infection, serious thought should be given to the pulmonary complications of fibrocystic disease of the pancreas, described by Andersen (2), and to mucoviscidosis, described by Farber (6). In these conditions abnormally thick and tenacious bronchial secretions lead to repeated episodes of bronchopneumonia and eventual interstitial fibrosis with emphysema. Zuelzer and Newton (16) have demonstrated that the pathologic process in the lungs is similar to that in the pancreas, consisting of an abnormal accumulation of viscid secretion in the air passages. They have also pointed out that the respiratory tract, in contrast to the pancreas, is accessible to secondary bacterial invaders, and that this secondary infection is perpetuated by inadequate drainage of the obstructed air passages, leading to progressive inflammatory changes. The patients studied in this series did not exhibit abnormally viscid mucus of the degree encountered in mucoviscidosis or fibrocystic disease of the pancreas, but excessive amounts of mucus were observed in several of the cases. The histologic findings typical of fibrocystic disease in the pancreas were not observed.

Another condition to be considered from the point of view of differential diagnosis is bronchiolitis in infants. This, however, is associated with peripheral pulmonary emphysema, of a generalized character, in contrast to the segmental distribution which we observed in the cases under discussion. Furthermore, bronchiolitis, although acute in onset, is of short duration, responds favorably to treatment, and rarely terminates fatally. The respiratory infections in our cases were recurrent and persistent, responding unsatisfactorily to therapeutic measures and terminating in death.

Asthma rarely occurs in the early months of life (10) and causes little confusion with the condition with which we are concerned. It is more common after two or three years of age and is characterized by paroxysmal dyspnea of an expiratory type. The respiratory difficulty seen in our patients with infection, emphysema, and atelectasis associated with congenital cardiac septal defects is of an inspiratory type, usually with marked retraction of the costal margins. The emphysema which may be observed with asthma is of a generalized nature, and atelectasis is uncommonly found.

DISCUSSION

Numerous conditions producing obstructive emphysema and atelectasis have been reported since Jackson, Spencer, and Manges (8), in 1920, described the ball-

valve mechanism of pulmonary emphysema caused by foreign body inhalation. Snow and Cassasa (14) have shown that acute respiratory disease in infants is often accompanied by severe emphysematous and atelectatic changes resulting from a check-valve mechanism. Overstreet (11) and Ferguson and Neuhauser (7) have described cases in which lobar emphysema was produced by absence of cartilaginous rings in the bronchus. Regional obstructive emphysema, as reported by Caffey (4), is a transient condition arising from bronchial obstruction of a check-valve type. One of us (5) described 2 cases in which deficient cartilage resulted in marked atelectasis. In 1 of these there were also intraluminal cysts.

Shaw (12) suggested the possibility of bronchial mucosal folds or chondromalacia of bronchial structures as the etiologic factor in localized hypertrophic emphysema. Recently, Sloan (13) has reported 4 cases in which lobectomy was successfully performed for lobar obstructive emphysema apparently due to abnormal flaccidity of the bronchial wall. No specific obstruction was found, and it is suggested that this abnormality also involves other portions of the bronchial tree.

Jersild and Riskaer (9) described a condition which they designated as "acute infectious atelectasis," a separate nosologic entity, occurring in 43 per cent of 178 infants who died with a diagnosis of pneumonia, bronchitis, or laryngotracheobronchitis. The high incidence of these atelectatic changes in children was attributed to a lesser "collateral respiration," due to their relatively greater amount of interstitial tissue, the small dimension of their bronchi, and their inability to cough or expectorate.

As stated at the outset, a definite etiologic factor or factors responsible for the high incidence of pulmonary infection with emphysema and atelectasis in association with intracardiac septal defects in infancy cannot be identified. Abbott (1) has stated that the patient with an intracardiac septal defect can look forward to a relatively normal life expectancy barring an intercurrent infection or some associated abnormality. Why, then, is there so marked a susceptibility to pulmonary infections?

Abnormal flaccidity of the cartilaginous rings in the tracheobronchial tree may be present to some degree in these patients and is difficult to detect. The bronchial lumen at autopsy may appear to be quite normal in caliber, but in the dynamic state which pertains during life it may be abnormally collapsible. The bronchial lumen narrows on expiration and expands on inspiration, a physiologic condition which would be accentuated by the presence of inflammatory changes in or by redundancy of the bronchial mucosa. Benda (3) has emphasized that lack of proliferation and regularity in the cranial bones which are derived from cartilage accounts for the abnormalities of the skull in mongolism. It is possible that similar cartilaginous deficiency may affect other cartilages in these children and account, at least in part, for their predilection to pulmonary infections and the profound interstitial fibrosis and emphysema which result. If the presence of a septal defect is, as it seems to be, a predisposing lesion to these pulmonary changes, it would be interesting to determine the incidence of such changes in mongoloid children who do not have a congenital cardiac abnormality.

The possibility of a congenitally deficient respiratory epithelium must also be considered. This is a specialized type of epithelial tissue which would fail to perform its function of evacuating the bronchi of mucus, foreign materials of various kinds, and inflammatory exudate if the ciliated columnar cell did not mature. Metaplasia occurs in the presence of infection, however, and autolytic changes taking place after death make this extremely difficult to evaluate. Terminal aspiration of gastric contents may also cause autolytic changes.

Although the excessive mucus observed in the bronchi and bronchioles of some of these patients was not of the very thick

and tenacious character found in fibrocystic disease of the pancreas and in mucoviscidosis, the possibility of this mechanism being present in lesser degree arises.

CONCLUSION

In an infant with a cardiac murmur, the observation of persistent and progressive, if variable, degrees of pulmonary atelectasis and/or emphysema is strongly indicative of an intracardiac and probably an interatrial septal defect.

The mechanism of these pulmonary changes is understood, but the etiology is not clearly evident. Several possible causative factors are considered.

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SUMARIO

Algunas Alteraciones Pulmonares Asociadas con Defectos de los Tabiques Intracardíacos en la Infancia

En un estudio de 26 lactantes que tenían defectos congénitos de los tabiques cardíacos, en 13 se observó invasión pulmonar en forma de atelectasia o enfisema, en tanto que de un grupo de 18 testigos con transposición de los grandes vasos, pero sin brechas en los tabiques, sólo 1 (5.5 por ciento) reveló alteraciones pulmonares.

La incidencia de las alteraciones pulmonares concomitantes alcanzó su máximo en los enfermos que tenían inoclusión del tabique interauricular: 6 de 7 casos, o sea 86 por ciento. La cifra para la malformación interauricular e interventricular combinada fué de 50 por ciento (5 de 10 casos) y para la malformación interventricular sola, 22 por ciento (2 de 9 casos). Preséntanse casos típicos, con hallazgos autópsicos.

No son manifiestos los precisos factores etiológicos de las alteraciones pulmonares, aunque parece, histopatológicamente, que la causa tal vez sea la viscosidad anormal de la secreción bronquial o el desarrollo anormal del epitelio bronquial.

DISCUSSION

John F. Holt, M.D. (Ann Arbor, Mich.): The roentgenologic observations of Drs. Krabbenhoft and Evans are particularly gratifying. They graphically support the clinical opinions of such authorities as Taussig, as well as Bing (Bing, R. J.: Physiology of Congenital Heart Disease. Nelson's Loose-Leaf Living Medicine), to the effect that patients with left-to-right shunts have frequent respiratory infections and, on the other hand, indirectly support the thesis that patients with pulmonic stenosis (a right-to-left shunt) have amazingly few respiratory infections. The latter concept is regarded as an important diagnostic sign by the members of the cardiovascular team in our hospital.

As indicated by the essayists, obstructive pulmonary changes due to tracheobronchial inflammation are not uncommon. In fact, in our experience, they represent the commonest manifestations of pulmonary infection in infants and young children with or without congenital heart disease. It seems logical to assume that patients with congenital heart disease have lowered resistance to pulmonary infection and do not have the recuperative powers of normal infants. Hence the peripheral pulmonary emphysema, which in uncomplicated bronchiolitis promptly responds to treatment, behaves differently in congenital cardiacs. The emphysema persists, becoming more pronounced, and obstruction in some portions of the lungs becomes complete. Air is absorbed in these portions of the lungs, producing patchy atelectasis and the segmental distribution of the obstructive phenomena which Dr. Krabbenhoft has described. It must also be kept in mind that the roentgenologic pattern of arterial vascular congestion of lungs in auricular septal defects may at times be difficult to differentiate from patchy atelectasis and pneumonitis.

Recognizing these generalities, which might easily cause one to doubt the accuracy of Dr. Krabbenhoft's observations, the fact remains that, in all cases presented, the roentgen findings are wisely substantiated with irrefutable histopathologic proof. A superficial review of the autopsy cases of septal defect seen at University Hospital indicates that our experience has been somewhat similar, although less dramatic. Precise statistics are not readily available, but it appears that a larger percentage of patients dying with septal defects have pneumonitis with associated atelectasis and emphysema than is true of those with other congenital cardiac lesions. A description of similar pulmonary abnormalities is conspicuously lacking in the necropsy reports of patients with pulmonic stenosis.

With all due respect to the essayists' suggestion that an underlying abnormal anatomic structure of the lung in patients with septal defects predisposes to the striking pulmonary changes which they have so beautifully recorded, it occurs to us that there is no readily discernible reason why associated developmental defects of the lung should occur more regularly in this type of congenital heart disease than in others. As one searches for a more likely explanation, it is difficult to dismiss the idea that the increased pulmonary blood flow which invariably occurs in septal defects must, in some way, be a contributing factor. This appears to be the one basic difference between those congenital cardiacs who are susceptible to repeated pulmonary infections and those who are not. At one extreme are the auricular septal defects with the largest pulmonary blood volume and the highest incidence of infection; at the other extreme we have pulmonic stenosis, with the least pulmonary vascularity and the fewest pulmonary infections. Paradoxical as the combination of increased vascularity and increased infection may seem, surely there must be some connection, although I do not profess to be able to explain it.

Body-Section Radiography with an Ultra-Fine Focal Spot Tube Utilizing Variable Magnification for Plane Selectivity[1]

MARTIN S. ABEL, M.D.

MANY METHODS and varieties of apparatus are in common use for body-section radiography, with variable movements of x-ray tube and film, or patient and film, or tube and patient, during the exposure (1–4). There is, however, one common underlying principle involved: In planes parallel to the selected plane there is relative motion of focal spot and film in opposite directions with or without synchronized motions in other directions. During the exposure, the angle of incidence of the primary beam with the plane of the film varies so that the image of the desired level is always projected onto the same area of the film, but images of the undesired levels are projected to shifting areas on and off the film and contribute only a blur of more or less uniformity over the film. It is also to be noted that, because of the varying angle of incidence of the primary beam, there is of necessity some blurring of the image of any selected level of finite thickness.

In 1944, Olsson (5) described a different method of tomography, applicable only to peripheral parts of the body which could be brought very close to the film. The method consisted in letting the x-ray tube move vertically during the exposure. Thus parts of the body at some distance from the film were blurred by the varying degrees of magnification and distortion contributed by the vertical motion, while parts in close approximation with the film were relatively clear. The method is of considerable value in visualization of such structures as the ribs, the temporomandibular joints, etc.

The method of selective blurring of undesired levels by variable magnification is susceptible to considerable refinement and extension with use of the fractional focus (0.3 mm. focal spot) tube. Apparatus for and examples of body-section radiography performed by this method were first exhibited by the author at the annual meeting of the Radiological Society of North America in 1951 (6).

METHOD

The procedure is quite simple. The x-ray tube and film move toward each other during the exposure along the same vertical axis perpendicular to the selected plane. If the tube and film move at equal speeds, the distances are pre-set so that the selected plane is midway between focal spot and film. This level, then, remains midway at all times during the exposure and is magnified at all times by a linear factor of two. All other planes are magnified at a variable rate and are blurred to a variable degree. Since at a magnification of 2 × the 0.3 mm. focal spot approximates a point source of x-radiation, the image of the selected plane is sharp and undistorted.

Figure 1 shows diagrammatically the effect described. Lines AA, BB, and CC are lines of equal length at different levels within the patient. Line BB is at the mid-level between focal spot and film at all times during the movement and is projected onto the film uniformly all during the exposure. The line AA is projected as A_1A_1 at the beginning of movement and as A_2A_2 at the end of movement. The distances A_1A_2 at each end are measures of the unsharpness of the projection of AA. Similarly the distances C_1C_2 are measures of the unsharpness of the projection of the line CC. It is to be noted that the unsharpness of the projection of CC is much less than that of AA, illustrating the fact that sharpness fades much more slowly below the mid-plane than above it. The greater the extent of motion and the closer to the patient the

[1] Accepted for publication in September 1953.

final position of the tube, the greater will be the blurring in planes both above and below the selected level, and the thinner will be the selected section.

If the tube and film move at different rates of speed, V_1 and V_2, respectively, then a level would remain in focus which would be $V_1/(V_1 + V_2)$ of the distance between focal spot and film and the rate of magnification will be in the ratio of $V_1 + V_2$ to V_1 in the selected plane. Thus, if the tube moves twice as fast as the film, the selected plane will be two thirds of the distance between tube and film, and the magnification in the selected plane will be 1 1/2 times.

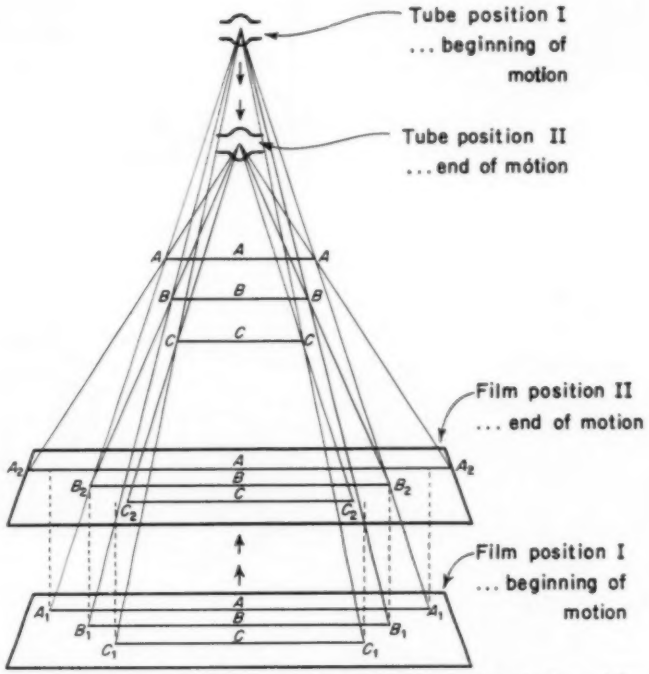

Fig. 1. Diagrammatic representation of effect of motion of tube and film on projections of lines AA, BB and CC. BB is midway between focal spot and film at all times during the movement in the course of the exposure, and its projection is unchanged throughout. The projections of AA and CC, respectively above and below BB, are not constant. Their images on the film are unclear by virtue of the penumbra formation to the extent of the difference in projected dimensions at the beginning and end of the motion.

APPARATUS AND TECHNIC

Figure 2 shows the apparatus in place. The movable cassette carriage is fitted to the horizontal bars of this model table and may be moved from one end of the table to the other independently of the tube stand. When in the desired position, the tube stand and carriage are locked in place by a horizontal bar. The vertical drive rod connecting the tube arm and carriage can be connected in a wide range of distances to allow for considerable variation in tube-patient, patient-film, and tube-film distances.

During the exposure the motor moves tube and film toward each other along the axis of the drive rod. The movement may also be made in opposite directions along the drive rod, but it is easier to control vibration of the tube and speed if the tube movement is downward. The rheostat regulates the speed of both tube and film, so that movement is faster as they ap-

proach each other. By varying the speed, but not the relative speeds, of movement of tube and carriage, the effect of the varying distance on exposure time is reduced, with the result that the quantity of radiation reaching the film is approximately even throughout the examination.

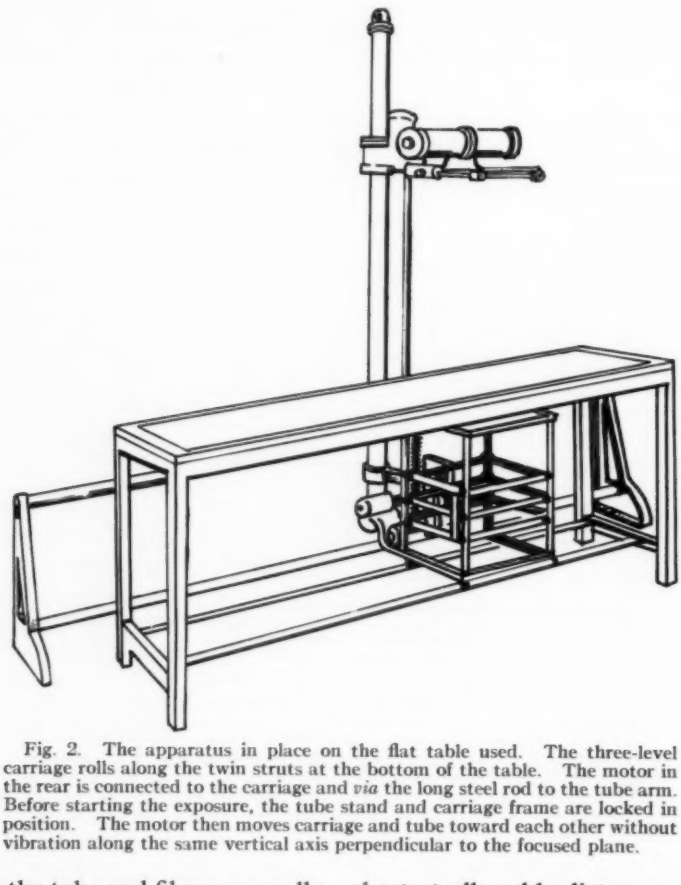

Fig. 2. The apparatus in place on the flat table used. The three-level carriage rolls along the twin struts at the bottom of the table. The motor in the rear is connected to the carriage and *via* the long steel rod to the tube arm. Before starting the exposure, the tube stand and carriage frame are locked in position. The motor then moves carriage and tube toward each other without vibration along the same vertical axis perpendicular to the focused plane.

In practice, the tube and film are usually moved at equal speed with the maximum amount of movement consistent with the equipment and size of the part rayed. Occasionally, with thick parts, it is desirable to move the tube twice as fast and twice as far as the carriage. The maximum motion gives the maximum blurring in planes above and below the selected level, as noted above. Another factor, however, secondary radiation, dictates the minimum allowable distance between patient and film. With the magnification technic, no grid or Bucky is necessary so long as sufficient distance intervenes between patient and film for the secondary radiation to become dissipated, attenuated, and relatively uniform. The smallest practical cone is habitually used, but the shortest allowable distance will, of course, vary with the thickness of the part to be examined. The technic using less motion of the carriage than tube allows maintenance of an adequate patient-film distance.

The carriage has three levels for cassettes, spaced 2 inches apart. These levels may be used singly, for a greater range of distances, or simultaneously. When they are used simultaneously, special non-lead-backed cassettes are employed in the upper two levels. Low-speed screens are used

in the top level cassette, par-speed screens in the middle level, and high-speed screens in the lowest level. With the three levels filled, a single exposure exposes all three films approximately equally, because of the graded screens. Three tomograms are thus obtained, at three levels, which are 1 inch apart if motion of tube and carriage is equal.

Accurate focusing and the use of a small cone are desirable, since the method is most accurate with the central beam. In the periphery of the field, a distortion factor is introduced because of a varying angle of incidence of the x-ray beam with the film during the movement.

The level selected is determined by the level of the suspected lesion closest to the tube, since the selectivity is somewhat skew, in that planes above the selected level are blurred much more than those below. For the same reason, it is desirable to position the patient so that the level of the lesion is closer to the table top, leaving as little normal tissue between the lesion and film as practicable.

RESULTS

As experimental proof of the theory, lead numbers were set up in a phantom at levels 2 inches apart. Figures 3A and 3B show, respectively, a routine film of the phantom and a tomogram focused at level "TWO." The focusing at the desired level is shown, as well as the blurring at the other levels, much greater at level "THREE," closer to the tube, than at level "ONE," closer to the film.

Figures 4A and 4B show routine magnified and tomographic films of the cervical spine focused at the mid-level of the vertebral bodies. The line indicated by the arrows is easily seen on the tomogram but is almost imperceptible on all routine films taken.

It is especially interesting to see the angulated continuation of this line, indicated by the uppermost arrow, conforming to the projection of the upper border of the vertebral body. This line was interpreted as a fracture, and this diagnosis conformed to the clinical findings and the mechanism of the trauma received.

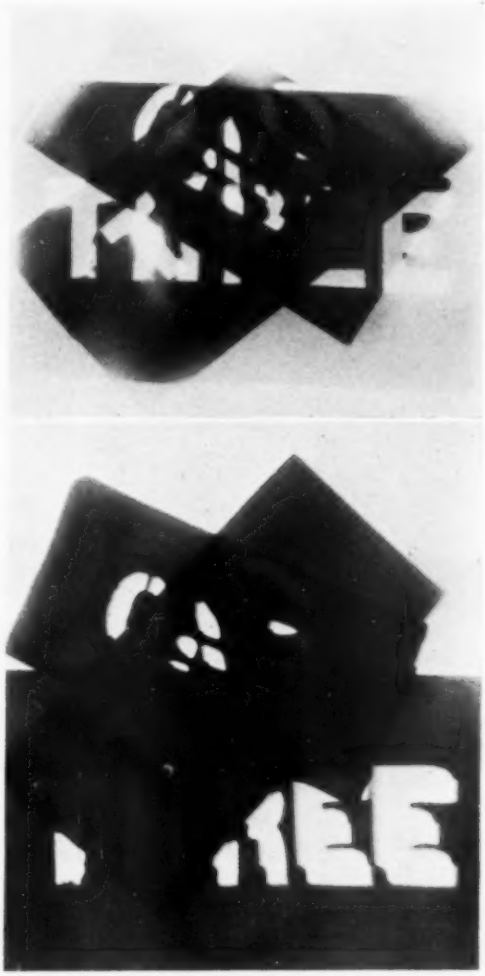

Fig. 3. A (above). Routine film of lead phantom with numbers "ONE," "TWO," and "THREE" at levels 3, 6, and 9 inches from the table top, respectively; tube-to-film distance 49 inches; mid-plane at level "TWO." No motion during exposure.

B (below). Tomogram of same phantom, with mid-plane at level "TWO." Tube and film moved 14 inches closer together during exposure. Note clarity of "TWO" and blurring of both "ONE" and "THREE." As predicted, the penumbra is greater about "THREE," the level closer to the tube, than about "ONE."

Figures 5A and 5B show a routine magnified film and tomogram of the cervicothoracic junction. Notable are the relative clarity of all mid-line structures in the tomogram—vertebrae, trachea, manubrium, etc.—and the blurring of the

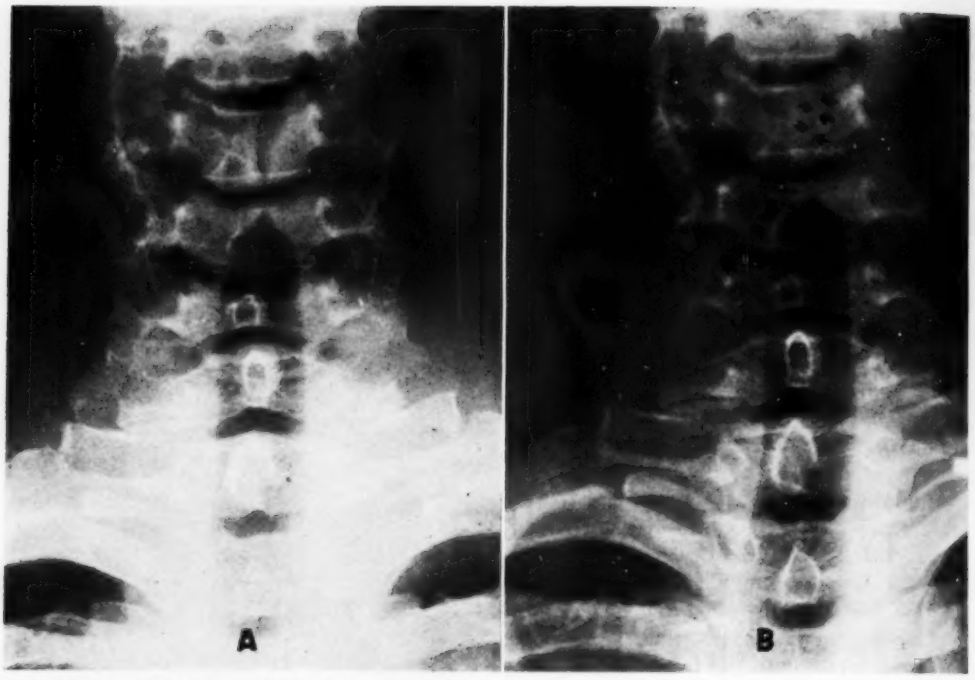

Fig. 4. A. Static magnified film of neck.
B. Tomogram of same patient focused at level of vertebral bodies taken on same date as 4A. The radiolucent lines indicated by arrows at levels of C4 and C5 are seen clearly, although they are indistinguishable on the static film. The line at C4 angulates in its upper portion to conform with the plane of the superior surface of the body of C4 and has the sharp, jagged appearance of a fracture. The clinical findings and the trauma which the patient had undergone were consistent with a fracture of C4.

humeral heads and other structures away from the mid-line.

DISCUSSION

The results obtained confirmed the theoretical prediction that a thick-section tomogram would be obtained of a skew character, in that the focusing drops off much more rapidly on the tube side than the film side. Inasmuch as the blurring is caused by formation of a penumbra about objects in planes other than the selected one, smaller details are lost rapidly, but larger structures remain identifiable at far distant levels. Thus a bony trabeculation 1.0 mm. in thickness will be completely blurred by a penumbra of 0.5 mm., but a bone 5 cm. in diameter will be easily recognizable with a penumbra of 1 cm. So, for fine details, only the selected section is in focus and is seen through the hazy interior of larger structures as objects are seen through a screen door.

The tomogram obtained by this method, then, is in some ways a combination of tomogram and conventional film. In contradistinction to other types of tomography the following advantageous aspects are of interest:

1. The resulting radiograph gives excellent detail in a section of substantial thickness, with adequate visualization of larger structures on either side of the level in focus.

2. Because of the thickness of section, it is not necessary to predetermine accurately the level of a lesion.

3. Because of the thickness of section, the three-dimensional aspects of a lesion can be appreciated, as well as its relationship to surrounding structures.

4. No factitious shadows are introduced,

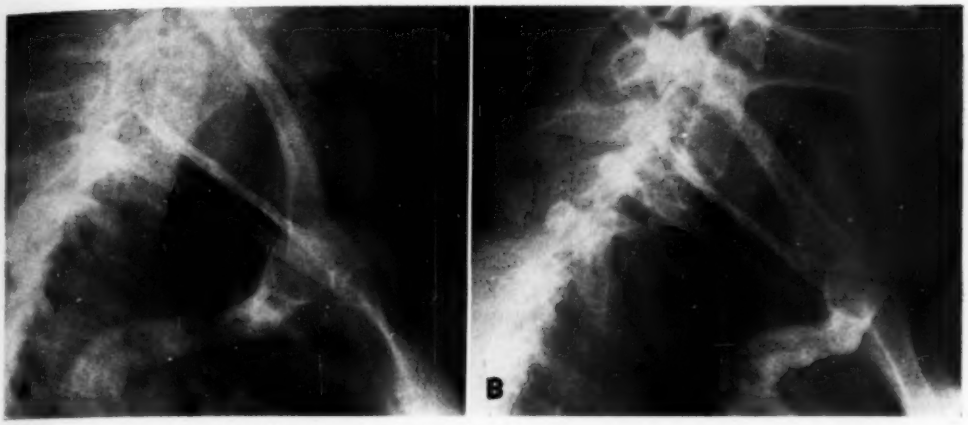

Fig. 5. A. Static magnified film of cervicothoracic junction.
B. Tomogram of same area focused at mid-plane of the patient. Note the clarity with which the lower cervical vertebrae are seen through the blurred outline of the humeral head and clavicle, which were closer to the tube. Other mid-line structures, as the larynx and top of the manubrium, are much clearer on this film than on the static view.

nor is there any disturbance of relationships or distortions except for the magnification and blurring intentionally utilized.

5. The method allows for the production of tomograms at multiple levels at a single exposure.

Similarly, in contradistinction to other forms of tomography the following disadvantageous aspects are to be noted:

1. It is not possible to get a thin section with complete blurring of other levels. Thus a small lesion in close relationship to a large dense structure is difficult to visualize.

2. The apparatus must be adjusted with extreme care. Any vibration of the tube during the exposure increases the effective focal spot size and introduces blurring with the magnification. If the movement of tube and film are not along the same axis with the x-ray beam exactly perpendicular to the film at all times, the method fails.

3. The fine focal spot tube operates at about 15 ma. or less, and the exposure time is necessarily long.

The magnification obtained is not uniform; structures closer to the tube are magnified more than those closer to the film, and the differential magnification is quite appreciable even for structures quite near together. Thus the resulting magnification is not that obtained with a magnifying glass or other methods of magnifying routine films, and a certain amount of reorientation is necessary for adequate evaluation of this type of film. An element of perspective is obtained which is often desirable and useful.

SUMMARY

A method and apparatus for body-section radiography have been described utilizing simultaneous movement of a very fine focal spot tube and film along the same axis, perpendicular to the selected plane. The resultant is a magnified projection wherein the selected plane is in focus and structures in other planes are blurred by a continually varying rate of magnification during the exposure. The method yields a thick-section tomogram with clarity fading more rapidly in the tube direction than in the film direction, but with larger structures in both directions still visible. Normal relationships are maintained, and no factitious shadows are introduced. The method allows for the simultaneous production of tomograms at multiple levels.

Inasmuch as the method depends on the use of a very small focal spot operating

at low milliamperage, the exposure time is protracted and extreme care must be taken to avoid any mechanical defects negating the effect of the small focal spot.

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SUMARIO

La Radiografía Seccional (Tomografía) del Cuerpo con un Tubo Focal Ultrafino que Utiliza Aumentos Variables para la Selectividad por Planos

Descríbense aquí un método y el aparato para la radiografía de secciones del cuerpo, utilizando el movimiento simultáneo de un tubo focal muy fino y de una película a lo largo del mismo eje, perpendicular al plano escogido. El producto es una proyección ampliada, en la que el plano escogido queda enfocado y aparecen borrosos los tejidos situados en otros planos por virtud de un coeficiente de aumento que varía constantemente durante la exposición. El método ofrece un tomograma en cortes gruesos cuya claridad se atenúa más rápidamente hacia el tubo que hacia la película, pero dejando todavía visibles los órganos más grandes en ambas direcciones. Mantiénense también las relaciones normales y no se introducen sombras ficticias. El método permite la producción simultánea de tomogramas a distintos niveles.

Dado que el método se basa en el uso de un punto focal muy pequeño que funcione con un miliamperaje bajo, se alarga el tiempo de exposición, y hay que desplegar sumo cuidado para evitar todo defecto mecánico que negative el efecto del pequeño punto focal.

Pulmonary Complications of ACTH and Cortisone: Roentgen Observations[1]

JOHN A. EVANS, M.D., and ISRAEL STEINBERG, M.D.

SERIOUS PULMONARY complications are known to occur during the course of ACTH or cortisone therapy for non-pulmonary conditions. Spain (13), in an excellent article on the biologic effects of cortisone as related to pulmonary disease, states that sufficient experimental data are available that it is now possible to understand some of the basic mechanisms by which these hormones produce both beneficial and harmful effects.

Two of the most significant effects of ACTH and cortisone are the suppression of the acute inflammatory process and the inhibition of the repair process. Spain (13) believes that there is a relationship between the degree of suppression of the inflammatory exudate and the dosage of ACTH or cortisone. An increase in the coagulability of the blood with thromboembolic complications has been associated with the use of these hormones (2). Their effects on the antigen-antibody reaction are controversial and still not clear (1, 5, 7, 11). The sodium and water retention properties are, however, well known.

Numerous experimental studies have been made of the effects of cortisone upon the course of tuberculous infection in various animal species, including man. Some of these have shown enhancement of the tuberculous process, others have not (6–10, 12, 14, 15). LeMaistre and Tompsett (8) have suggested that the difference in effects in animals may be explained by individual species variations in response to the hormone. Spain, in the paper referred to above, states that he has observed a patient with a previously negative tuberculin test and a clear chest roentgenogram in whom disseminated tuberculosis appeared following the use of cortisone. In this same article he quotes a personal communication from Sokoloff (Bellevue Hospital, New York City) citing a number of cases treated with cortisone for a wide variety of conditions, with subsequent development of pneumonia. Such cases coming to autopsy showed the histologic picture of pneumonia seen in agranulocytosis.

The authors have recently seen serious pulmonary complications in a number of patients receiving ACTH or cortisone for non-pulmonary disease. It is felt that a presentation of the roentgen features in these cases, while not adding to existing knowledge of the causative mechanisms, may nevertheless be of interest. Severe pulmonary complications during or following the use of these hormones may be more common than the present literature indicates. Such complications can easily be overlooked due to the masking of symptoms by the suppression of the inflammatory exudate and the feeling of euphoria that usually accompanies this form of therapy.

CASE REPORTS

CASE 1. *Miliary Tuberculosis Following Cortisone Treatment for Suspected Lymphoma:* D. D., a 22-year-old white male, was seen on his fourteenth hospital admission. For seven years he had had recurrent bouts of fever and mediastinal lymphadenopathy. He was suspected of having a lymphoma, although histologic proof was never obtained. Intensive irradiation and nitrogen mustard had produced remissions on past occasions, the remissions appearing to be longer after x-ray therapy. On this last admission he was desperately ill, with high fever, and tri-ethylene melamine (TEM) and cortisone were given as a last resort. At first, his condition improved, but temperatures ranging from 36 to 40° C. recurred.

Two weeks after admission the patient suddenly went into shock, the blood pressure fell to 86/46 and the hemoglobin to 8.3 gm. He was given two transfusions of packed cells but became confused

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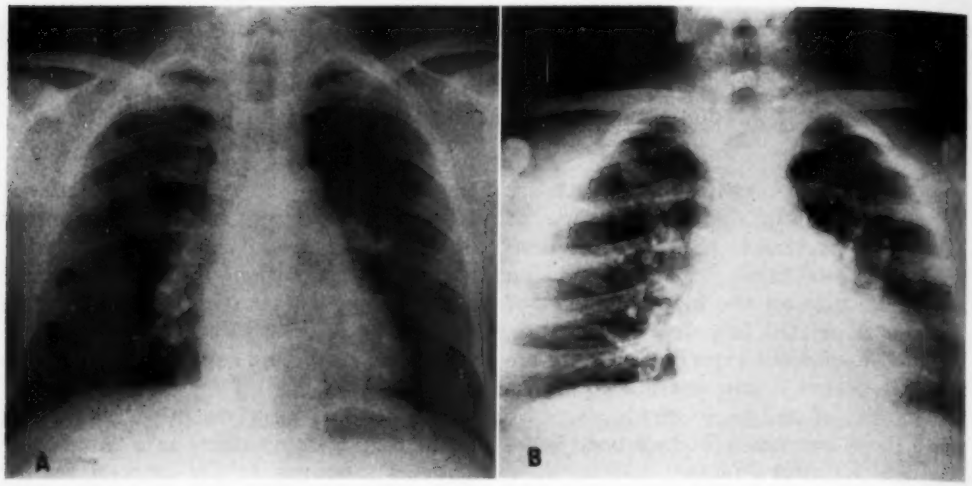

Fig. 1. Case I: Pulmonary and generalized miliary tuberculosis complicating cortisone therapy for suspected mediastinal lymphoma.

A. April 23, 1952. Frontal roentgenogram demonstrating ill-defined infiltrate in right first anterior interspace not present on previous chest studies. The mediastinal and hilar adenopathy with calcification had been present on all previous films.

B. May 10, 1952. Lordotic film, revealing some increase in the right upper lobe infiltrate and a fine generalized granular appearance of the lung fields.

and disoriented, and began to cough up blood-tinged sputum; râles developed throughout both lungs. The subsequent course was rapidly downhill and death occurred one month after admission. The patient had received 6 gm. of cortisone. A significant finding during his last illness was positive gastric washings for acid-fast bacilli.

Roentgen Findings: On the day following admission, April 22, 1952, a chest roentgenogram (Fig. 1A) revealed enlarged hilar nodes. These had been observed on films taken previously. A new finding was a small infiltration in the right first anterior interspace. Subsequent roentgenograms disclosed no change until May 10 (Fig. 1B), when there was some increase in the small right upper lobe infiltrate with the margins appearing more distinct. There was also a suggestion of fine nodular stippling in the lung fields. The hilar nodes remained unchanged.

Postmortem Findings: The necropsy diagnosis was fibrocaseous pulmonary tuberculosis with generalized miliary dissemination. Both pleura contained fibrous adhesions and many scattered small, firm, white nodules, measuring 1–3 mm. At the right apex was a firm, white nodule, 2.0 × 2.5 cm., with a soft caseonecrotic center surrounded by a narrow fibrous scar. The hilar nodes were enlarged, and on cut section were found to be filled with whitish caseous material; one was calcified. Liver, spleen, kidneys, and small bowel showed similar nodules, 1 to 2 mm. in diameter. Surrounding the portal vein was a 4 × 6-cm. area of whitish-yellow caseous material. There were a few enlarged mesenteric nodes, and within the mucosa of the ileum were three small ulcers.

Microscopic examination showed well defined tubercles with central caseation; epithelial and Langhan's giant-cells were present throughout the parenchyma of the lungs, spleen, and kidneys. Acid-fast smears from the liver and lungs revealed tubercle bacilli.

Comment: Ewing (4) said that tuberculosis follows Hodgkin's disease like a shadow. Though in this case no evidence of lymphoma was found on necropsy, it is possible, nevertheless, that the patient did have a lymphoma eight years prior to his death and that it regressed with the intensive treatment he received. The nodule in the apex of the right lung had the appearance of a lesion of some duration. The miliary dissemination found throughout the rest of the body indicated a terminal spread, probably precipitated by the administration of cortisone.

CASE II: *Caseous Pneumonia Following Cortisone Treatment for Disseminated Lupus Erythematosus:* A 24-year-old Negress was seen at Sydenham Hospital (services of Drs. Emmanuel Applebaum and George Friedman). She was admitted on June 10, 1950, complaining of chest pain, high fever, dyspnea, and painful swollen joints. Her

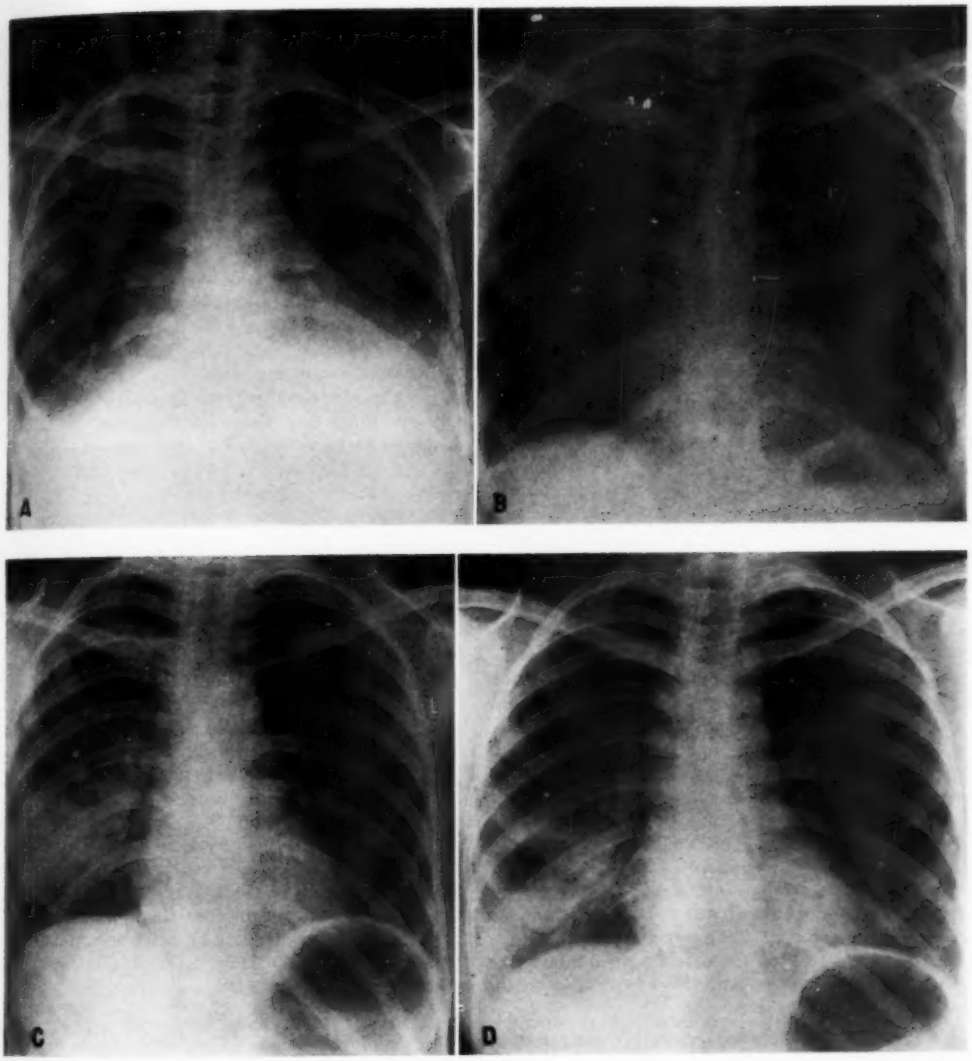

Fig. 2. Case II. Caseous pulmonary tuberculosis right upper lobe complicating cortisone treatment for disseminated lupus erythematosus.

A. June 19, 1950. Admission roentgenogram revealing bilateral pleural and pericardial effusions.

B. Sept. 14, 1950. Disappearance of pleural and pericardial effusions, leaving only right costophrenic sulcus obliterated. The lung fields are clear. Despite the improvement in appearance of the chest, the patient still had a fever, joint pains, and rash.

C. Rounded area of pneumonia in right lower lobe after one month of cortisone therapy. Sudden onset of cough, fever, and râles followed long period of well being.

D. Subsequent chest film, revealing a large cavity. Sputum positive for acid-fast bacilli.

illness began abruptly one month previously with swelling of the wrist and shoulder joints, which were edematous, hot, and painful. The past history was unremarkable. The patient appeared acutely ill, with temperature of 104.6° F., respirations 40, pulse 130; and blood pressure 122/70. There was dullness at both bases, with diminished to absent breath sounds and a few moist râles. Heart sounds were distant, the rate was regular, and there were no murmurs. The liver was enlarged two fingerbreadths below the costal margin. There was no leg edema but the wrists, fingers and shoulder joints were stiff, swollen, and exquisitely tender to touch and motion. A diffuse maculopapular

erythematous rash was present over the back and buttocks.

A chest roentgenogram (Fig. 2A) showed fluid at both bases with clear lung fields above. There was also evidence of a pericardial effusion. Thoracentesis on the right, on June 23, yielded 400 c.c. of clear yellow fluid, with a specific gravity of 1.015. This was sterile on smear and culture and failed to grow tubercle bacilli. Examination of the blood showed hemoglobin 45 per cent (7 gm.); red blood cells 2,900,000; white blood cells 9,000, with a normal differential count; sedimentation rate, 25 mm. in one hour. Serologic examination was negative. Urinalysis was unremarkable.

The patient was kept in bed and treated symptomatically. Although the pleural and pericardial effusions disappeared (Fig. 2B), she continued to have fever, dyspnea, and joint pains. Finally, because disseminated lupus erythematosus was suspected, treatment with cortisone was begun on Dec. 7, 1950, six months after admission. Almost immediately the patient began to improve: the fever subsided, the heart and respiratory rates slowed, and there was a lessening of joint pains and edema. Suddenly, on Jan. 11, 1951, high fever, cough, and expectoration recurred. A week later râles were heard at the right base. Tuberculosis was suspected, and a chest film disclosed a large rounded infiltration in the right lower lobe which subsequently became the site of a large cavity with a fluid level (Fig. 2, C and D). On Feb. 9, the sputum was positive for tubercle bacilli. Streptomycin and para-aminosalicylic acid therapy was started, and the cortisone was discontinued. Just over 6 gm. of cortisone had been administered in a period of two months. On Feb. 20, special plasma studies revealed the classical "LE phenomenon" establishing the diagnosis of lupus erythematosus. By March 13, the patient was sufficiently improved to permit transfer to a sanatorium. After a year there was clearing of the caseous pneumonia, the sputum was negative, and she was discharged as a case of arrested tuberculosis.

Comment: This is a striking example of the sudden appearance of an area of caseous pneumonia in a patient given cortisone for disseminated lupus erythematosus. The hormone, in this instance, brought about a dramatic subsidence of all the toxic manifestations of the lupus but produced a serious pulmonary complication. Prior to the appearance of the acute tuberculous pneumonia, the patient had no roentgenological evidence of pulmonary tuberculosis. Discontinuance of the cortisone and the institution of antituberculous treatment effected an arrest of the tuberculosis.

CASE III: *Pulmonary Edema Following ACTH for Rheumatic Carditis:* H. W., a 14-year-old schoolboy, with history of rheumatic heart disease since the age of seven, was admitted to the hospital on March 11, 1950. The present illness was his fourth attack of acute rheumatic fever and carditis. A chest roentgenogram on the following day (Fig. 3A) showed pulmonary vascular congestion with cardiac enlargement. Blood cultures were negative.

Course: The patient was placed on a 1,500 calorie, 3 gm. salt diet. On the second hospital day his condition became worse. The temperature rose to 40.2° C., respirations were labored and 60 per minute, with a pulse rate of 120 per minute. Nasal oxygen relieved the labored respiration, although the rate remained high. Left precordial pain was present and unrelated to respiration. On the third day the administration of ACTH, 25 mg. four times daily, was started. Despite a drop in temperature, the patient's condition remained unimproved and a chest film (Fig. 3B) after three days of ACTH showed an increase in the pulmonary congestion.

This case presented a difficult diagnostic and therapeutic problem, in that, if cardiac failure was the chief source of difficulty, ACTH was probably contraindicated. However, because of the calculated beneficial effect of ACTH on rheumatic carditis, it was decided to continue this medication, supplementing it with penicillin. The patient's condition continued critical over the next few days, and on the ninth hospital day (the seventh day of ACTH therapy) the ACTH was discontinued. The next day moderate diuresis occurred. Roentgen examination (Fig. 3C) revealed a marked decrease in the pulmonary congestion. Following this, diuretics were given daily. In the next five days the patient lost 4.8 kg. weight. Paralleling the diuresis and weight loss there was a marked and steady improvement in his condition, and a chest film on March 29 (Fig. 3D) showed complete clearing of the congestion.

Comment: In this case the ACTH apparently contributed to the patient's congestive failure, for when the drug was discontinued he immediately began to improve. This is an example of the sodium and water retention effects of the drug.

CASE IV: *Probable Pulmonary Infarction During Cortisone Therapy for Acute Myelogenous Leukemia:* E. B., a 22-year-old Puerto Rican housewife, was found to have acute myelogenous leukemia on sternal marrow examination. Past and family histories were unremarkable, and there was no history of exposure to tuberculosis.

Examination showed a well developed, thin female acutely ill and in a severe febrile state. There were many petechiae on the right arm and body

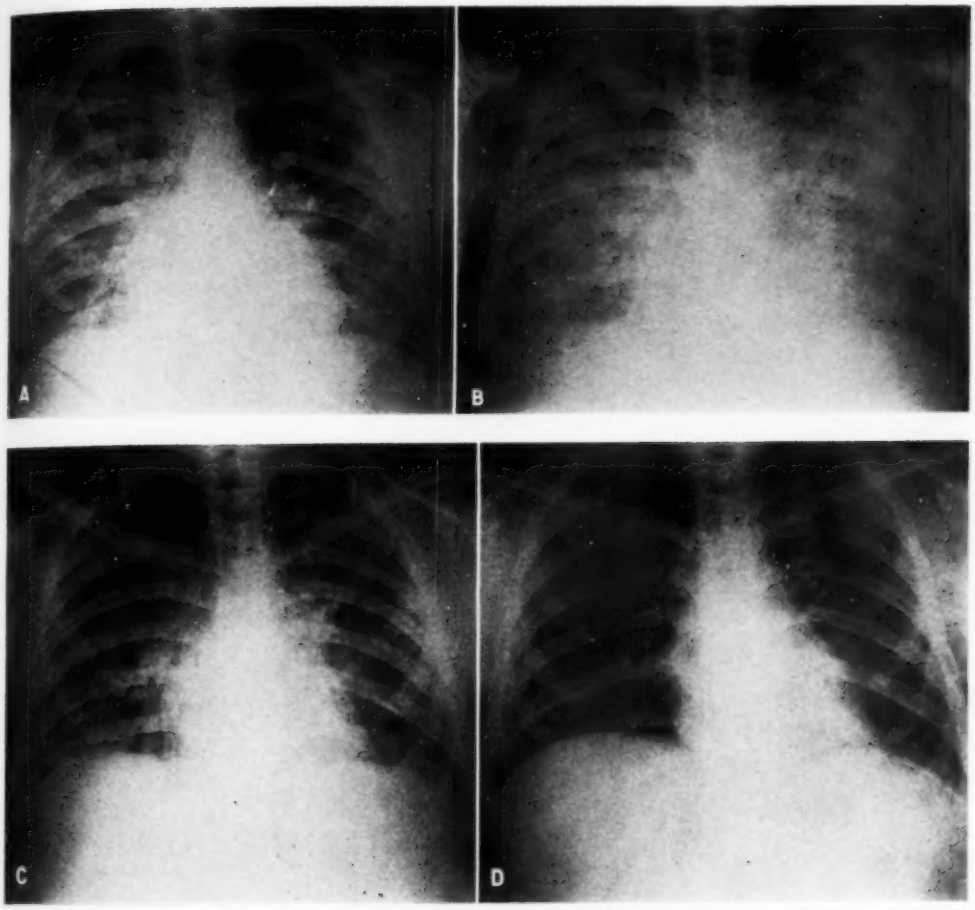

Fig. 3. Case III: Water retention effects of cortisone.

A. March 12, 1950. Admission roentgenogram of 14-year-old boy with acute rheumatic fever and carditis, showing an enlarged heart and pulmonary congestion.

B. Film obtained six days later (three days after initiation of ACTH), revealing marked increase in pulmonary congestion.

C. March 23, 1950. Examination twenty-four hours following discontinuance of ACTH, demonstrating marked subsidence of the pulmonary congestion.

D. March 29, 1950. Normal heart and lungs.

and several ecchymoses on the legs. The mucosa of the mouth was fragile and tender, with bleeding gums, and an ecchymosis was present on the left palate. Cervical, inguinal, femoral and epitrochlear nodes were enlarged. The hemoglobin was 5.5 gm.; platelets greatly reduced; white blood cells 79,000 (80 per cent blasts); red cells 2,100,000.

Course: On the second hospital day, Feb. 6, 1950, a roentgenogram revealed a moderate right and small left pleural effusion (Fig. 4A). The patient was started on cortisone, 100 mg. b.i.d. She continued to run a febrile course and chest examination showed many râles, dullness, and altered breath sounds throughout. On Feb. 18 (Fig. 4B), mottled densities were visible in the mid portions of both lungs and an abnormal prominence of the hilar shadows. The latter might represent engorged vessels. If so, the parenchymal changes could be explained on the basis of pulmonary congestion. If, however, the hilar prominence was the result of adenopathy, then the lung findings could be due to leukemic infiltration.

Sputa, gastric washings, and pleural aspirate were negative for acid-fast bacilli. On Feb. 28 (Fig. 4C), there was evidence of clearing of the lung infiltrations. Although the patient felt better, additional nodes appeared and the white blood cells rose to a peak of 320,000. The cortisone was increased to 400 mg. per day, following which there was a marked decrease in the leukocytes both

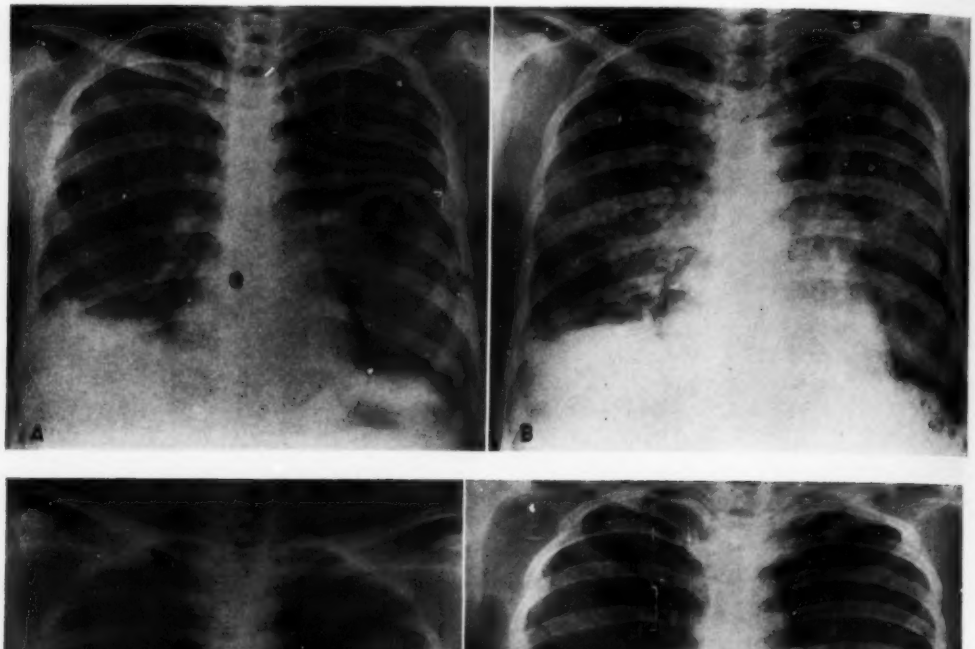

Fig. 4. Case IV: Pulmonary infarction complicating cortisone treatment for acute leukemia.
A. Feb. 6, 1950. Moderate right pleural effusion and slight blunting of left costophrenic sulcus.
B. Feb. 18, 1950. Some decrease in fluid at right base. The lungs now show widespread mottled densities most pronounced in mid portions and at hili. The heart appears larger than on preceding examination. The increased density at the lung roots might represent engorged vessels or hilar adenopathy.
C. Feb. 28, 1950. Marked increase in pulmonary densities and disappearance of fluid at right base.
D. March 13, 1950. Lungs, mediastinum, and heart appear normal.

peripherally and in the marrow. By March 2, the white blood count was 39,000, and the marrow count 125,000 with 5 per cent blasts. On March 9, the white count was 6,400. The patient was considerably improved but showed a moderate euphoria. By March 13, the chest (Fig. 4D) appeared normal. Though the patient was asymptomatic, a routine roentgenogram on April 4 (Fig. 4E), disclosed the presence of a large round lesion in the right lower lung field measuring 8 cm. in diameter. In addition, there was an irregular area of increased density adjacent to the left hilus. Four days later (Fig. 4F) the infiltration in the right lung was smaller, but both lesions now contained cavities. The appearance suggested necrotic infarctions or perhaps bizarre, partially necrotic, leukemic consolidations.

Despite these lung changes the patient remained asymptomatic. However, from April 7 to 10, she became withdrawn, cried frequently, and seemed morose, a psychosis having been precipitated by cortisone. She had received a total dose of 22.6 gm. of the drug. Although a hematologic remission was obtained, it was necessary, because of the persistent personality disorder to transfer the patient to a psychiatric institution.

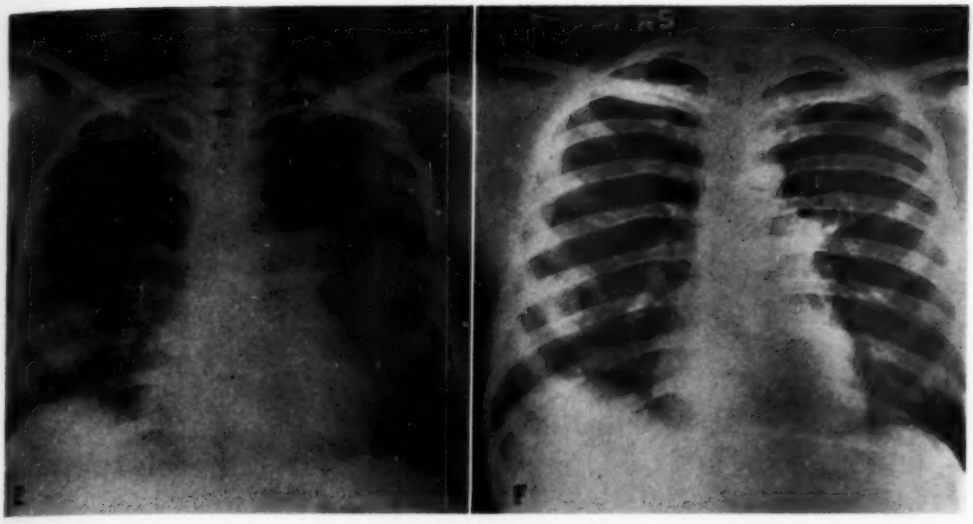

Fig. 4. E. April 4, 1950. Appearance of large round density in right lower lobe and smaller density adjacent to left hilus. Patient asymptomatic. Both lesions were considered to represent areas of infarction.
F. April 8, 1950. Patient continued asymptomatic. Density in right lower lobe shows considerable regression but a small central area of radiolucency has appeared. Cavity in left hilar lesion.

Comment: There is some uncertainty as to the interpretation of the chest roentgenograms in this case. The lung infiltrations on the examinations of Feb. 18 and 28 (Fig. 4, B and C), might represent pulmonary congestion or leukemic infiltration. One might infer that the changes were not those of congestion because of the subsequent clearing of the lung fields while the patient was still receiving large doses of cortisone. If this was, in fact, congestion, the cortisone might be expected to sustain and intensify it, as was the situation in Case III. However, the exact nature of the lung involvement at this time, as well as the later asymptomatic development of two large round lung lesions (Fig. 4C), remains speculative. It has been shown by Cosgriff (2) that thrombo-embolic phenomena and hypercoagulability of the blood are associated with the administration of ACTH and cortisone. It is probable, therefore, that the latter complication represents necrotic pulmonary infarction.

CASE V: *Pulmonary Infection of Unknown Etiology Following Cortisone Treatment for Rheumatoid Arthritis:* M. D., a 70-year-old woman, was seen on Feb. 16, 1953, through the courtesy of Drs. Marion Tyndall and Carl Muschenheim. The patient had been admitted to the hospital nine months earlier with typical rheumatoid arthritis of the extremities which was unrelieved by salicylates but dramatically improved after cortisone. She was well enough to be discharged after only six days, having received 1,200 mg. of cortisone. Following this, the cortisone was gradually reduced, and at the time of her second admission she was on a maintenance dose of 12.5 mg. daily. She had remained asymptomatic until six weeks previously, when she began having epigastric pains, nausea, and vomiting, resulting in a 10-pound weight loss. There were no abnormal joint or chest findings. Barium meal studies demonstrated a prepyloric ulcer on the lesser curvature.

A chest roentgenogram on June 12, 1952, on first admission, was normal (Fig. 5A). One taken on the second admission, Feb. 17, 1953, revealed multiple, soft-appearing ill-defined densities throughout the upper third of both lungs (Fig. 5B). Subsequent films (Fig. 5, C and D) showed further spread of the pulmonary infiltrations and multiple cavity-like lesions, varying in size from a few millimeters to 1.5 cm. in diameter. Despite the frightening appearance of the roentgenogram the patient had no symptoms referable to the lungs.

Subtotal gastrectomy was done on March 24, because of the possibility of a malignant gastric ulcer. Pathological study of the resected specimen, however, revealed an acute ulcer with no evidence of malignancy. The patient tolerated the pro-

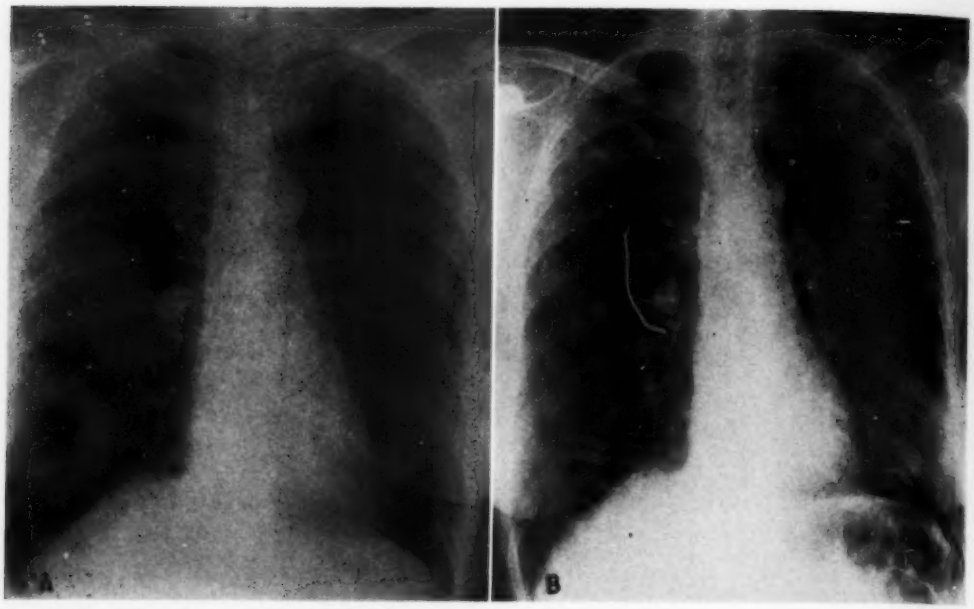

Fig. 5. Case V: Pulmonary infection of unknown etiology following cortisone therapy for rheumatoid arthritis.
A. June 12, 1952. First hospital admission. The lungs are clear; mediastinal and cardiovascular structures normal.
B. Feb. 19, 1953. Second hospital admission after patient had been on cortisone nine months. Multiple, soft, ill-defined densities throughout upper third of both lungs.

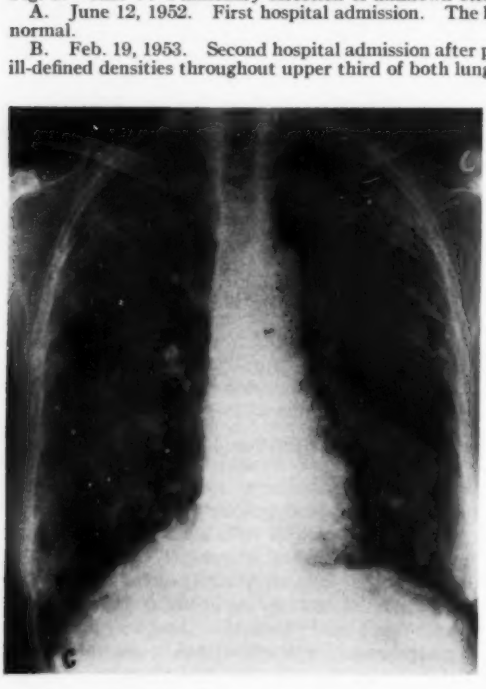

Fig. 5. C. March 10, 1953. Spread of infiltration to all lobes, with multiple cavity-like lesions varying in size from a few millimeters to an average of 1.5 cm. Patient asymptomatic.

cedure well, became asymptomatic and was soon discharged.

When the patient was forty years of age, she had been suspected of having tuberculosis and spent eight months in a sanatorium. The sputum was never positive, however, and no lesions could be found on chest roentgenography. During her present admission, sputum, gastric smears, and cultures were repeatedly negative for the tubercle bacillus. Though the etiology of the bizarre pulmonary infiltration remained obscure, and because tuberculosis could not be excluded, the patient was given anti-tuberculous therapy prior to her discharge. In spite of this, no change in the roentgen appearance of the lung has occurred (Fig. 5E). The patient remains asymptomatic, and sputa and gastric washings continue negative.

Comment: One could presume, in this case, on the basis of the history of pulmonary tuberculosis, that the present lung infiltrations represent a tuberculous process activated and disseminated as a result of the cortisone therapy. There is, however, no satisfactory evidence that any such presumption is justified. Sputa, gastric washings and cultures have all

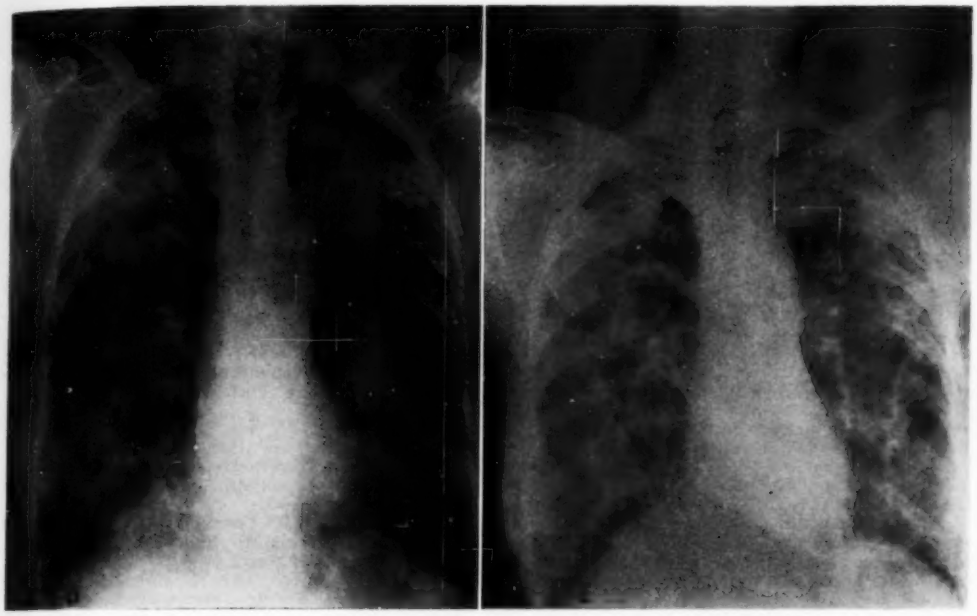

Fig. 5. D. April 9, 1953. Widespread pulmonary changes persist. Patient asymptomatic and discharged from the hospital two days later.
E. Oct. 7, 1953. Six months following discharge. Patient still asymptomatic despite unchanged appearance of lung fields.

been negative, and the patient is asymptomatic. Although the nature of the pulmonary infiltrations remains obscure, it does not seem unreasonable to attribute the pulmonary complication to the effects of cortisone.

DISCUSSION

The relation of the dosage of the hormones and the duration of administration in the cases herein reported are worthy of comment. Cases I, II, and IV had intensive cortisone therapy. In Case I over 6 gm. of the drug were given in a month; in Case II, 6 gm. in a period of two months; in Case IV, 22.6 gm. in two months. In Case V the patient had been on a daily maintenance dose of 25 mg. for six months prior to hospital admission.

Case I emphasizes Spain's advice (12) that before ACTH and cortisone therapy is instituted a routine chest film should be taken to exclude the possibility of any latent or incipient tuberculous focus. Cases II and V show that, even with this precaution, serious pulmonary complications may occur. The nature of the pulmonary disease in Case V is still unknown; it is our feeling that the lung changes represent a diffuse interstitial pneumonitis resulting from a suppression and inhibition of the inflammatory and repair processes.

It would appear that dosage is a likely factor in the production of pulmonary complications in patients treated with ACTH and cortisone. Large doses of the drug or small doses maintained over long periods seem to be predisposing factors.

SUMMARY

Five cases are presented in which serious pulmonary disease complicated the course of patients treated with ACTH and cortisone. The complications fall into four categories: (1) tuberculosis, miliary and pulmonary; (2) pulmonary congestion; (3) pulmonary infarction; and (4) pneumonitis of unknown etiology. Some of

the significant biologic effects of these agents and the mechanisms of their production have been reviewed. It is predicted that more pulmonary complications will be found in patients receiving ACTH or cortisone if routine chest roentgenograms are made, particularly if large or prolonged doses are given.

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SUMARIO

Complicaciones Pulmonares Debidas a la Corticotropina y la Cortisona: Observaciones Roentgenológicas

Preséntanse 5 casos en los que una afección pulmonar grave complicó la evolución de enfermos tratados por dolencias extrapulmonares con corticotropina y cortisona. Las complicaciones corresponden a cuatro categorías: (1) tuberculosis, miliar (granulia) y pulmonar; (2) congestión pulmonar; (3) infarto pulmonar; y (4) neumonitis de etiología desconocida. Repásanse algunos de los importantes efectos biológicos de dichos agentes.

Parece que la dosis constituye un factor probable en la producción de complicaciones pulmonares en enfermos tratados con corticotropina y cortisona. Las dosis grandes, o las pequeñas mantenidas durante períodos prolongados de tiempo, parecen ser factores predisponentes.

Arteriographic Demonstration of External-Internal Carotid Anastomosis Through the Ophthalmic Arteries[1]

JUAN M. TAVERAS, M.D., LESTER A. MOUNT, M.D., F.A.C.S., and RICHARD M. FRIEDENBERG, M.D.

IN ARTERIOGRAMS obtained months after carotid occlusion in the neck, it has been possible to demonstrate anastomosis between the internal and external carotid arteries by way of the ophthalmic artery.

It is the purpose of the present paper to report 3 cases in which these anastomotic pathways have been demonstrated arteriographically following ligation of the internal carotid artery in the neck for intracranial aneurysms and 1 case following spontaneous thrombosis of the artery. In most cases, after ligation or thrombosis of the internal carotid artery, circulation in the ipsilateral hemisphere is established through the anastomotic channels of the circle of Willis. The study of that type of collateral circulation is not within the scope of this paper and will be the subject of a subsequent report.

In the literature, references to collateral circulation through the ophthalmic artery are found in papers by Seaman, Page and German (6), by Torkildsen and Koppang (8), and by Denny-Brown (2). Each of these contributions refers to 1 case with this finding. All 3 patients suffered from spontaneous carotid thrombosis.

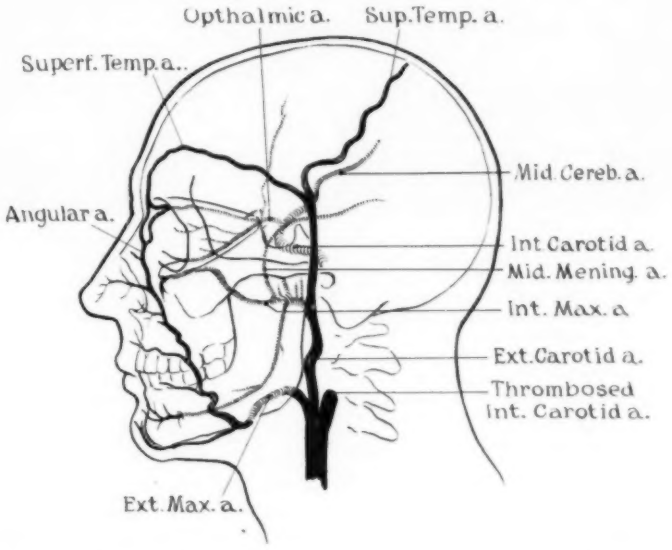

Fig. 1. Diagram to illustrate the anastomotic pathways between the internal and external carotid arteries through the ophthalmic artery. This diagram was based on the arteriogram of Case IV.

ANATOMY

It is a known anatomical fact that small anastomotic branches exist between the external and the internal carotid arteries. Four groups of anastomotic vessels have been described (Fig. 1): (*a*) Branches of the superficial temporal artery

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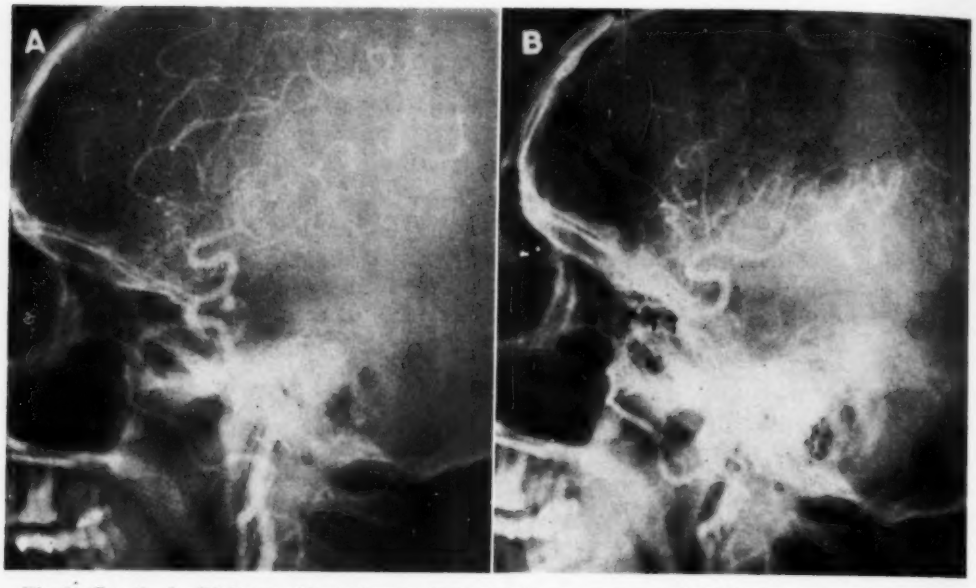

Fig. 2. Case I. A. Right carotid arteriogram demonstrating an aneurysm of the internal carotid artery in the region of the junction between the carotid siphon and the posterior communicating artery.
B. Film from a postoperative angiographic study done four months after ligation of the internal carotid artery in the neck. The injection was made below the site of the ligation. This film, which was made at two and a half seconds, demonstrates a large ophthalmic artery (arrows) and excellent filling of the middle cerebral artery and its branches, but not of the anterior cerebral artery, which is supplied by the opposite internal carotid artery.

anastomose with the lacrimal and palpebral branches of the ophthalmic artery. (*b*) The angular artery (terminal branch of the external maxillary artery) anastomoses with the inferior palpebral and the dorsonasal branch of the ophthalmic artery. (*c*) Orbital branches of the middle meningeal pass through the superior orbital fissure, or sometimes through separate canals in the greater wing of the sphenoid, and anastomose with the lacrimal or other branches of the ophthalmic artery. (*d*) The infra-orbital branch of the internal maxillary anastomoses with the dorsonasal branch of the ophthalmic artery.

These anastomotic branches are small and normally contribute very little to the circulation of the brain. Shenkin, Harmel and Kety (7) reported that only 2.7 per cent of the blood in the internal jugular vein normally comes from extracerebral sources and asserted that in man the external carotid system does not participate in the blood supply of the brain. On the other hand, Dandy (1) has pointed out that reduction of the lumen of the internal carotid artery to one-half or less forces the collateral channels of the circle of Willis to enlarge and carry an additional load to the brain. It is reasonable to assume that similar enlargement of the anastomotic branches between the internal and external carotid systems by way of the ophthalmic artery may take place. Poppen (5) considers this a likely possibility.

REPORT OF CASES

CASE I: S. I., a 55-year-old woman, was admitted to the Neurological Institute of New York on Feb. 26, 1952, complaining of pain in the right eye and forehead, drooping right eyelid, double vision, headaches, nausea, vomiting, and stiffness of the neck. Ptosis of the right eyelid had been present for eight days, and the other symptoms since the night prior to admission. Findings on examination were: pulse 60; blood pressure 200/90; papilledema and complete dysfunction of the right third nerve. Lumbar puncture revealed grossly bloody spinal fluid with 57,000 red blood cells per cubic millimeter.

Ten days following admission, an arteriogram was obtained, demonstrating a saccular aneurysm of the right internal carotid artery at the junction

between the carotid siphon and the posterior communicating artery, measuring 1.0 cm. in length and 0.7 cm. in width (Fig. 2A). A Selverstone clamp was applied to the internal carotid artery in the neck. After complete obliteration of the right internal carotid artery, the mean arterial pressure above the clamp fell 60 per cent. Simultaneous bilateral occlusion of the internal carotid arteries dropped the pressure to almost zero. It was felt, therefore, that ligation of the internal carotid artery would be successful in causing thrombosis of the aneurysm or in reducing the pressure and pulsation, thereby allowing the walls of the aneurysm to become thicker and in less danger of rupturing. The Selverstone clamp was closed at 12 noon. At 10 P.M. on the same day, the patient became confused, and a partial left hemiparesis developed. The clamp was opened slightly; the hemiparesis cleared promptly, and the patient became alert. Four days later the clamp was again closed completely, but was again opened after twenty-six hours because of the onset of confusion and left hemiplegia. There was complete return of function within a few minutes. After six days the clamp was closed completely for the third time, with no ill effects.

Four months later the patient was readmitted for repeat arteriography. She had remained well clinically, aside from partial right ophthalmoplegia. To our surprise, the arteriogram made at this time showed good filling of the middle cerebral artery and its branches and of the carotid siphon in late arterial phase, but only the portion of the internal carotid artery situated in the region of the sella turcica was filled with Diodrast and probably would have been missed with single film technic. The sequence of events could easily be traced on the serial films. The ophthalmic artery was two or three times larger than it was seen to be in the original arteriogram. The aneurysm did not fill at this time (Fig. 2 B).

CASE II: E. T., a 55-year-old woman, was admitted to the Neurological Institute on June 11, 1952. She had been well until the day of admission, when she suddenly experienced a severe headache and pain around the right eye. The headache extended to the back of the head and down the back of the neck. This was followed by an episode of vomiting, numbness and inability to move the legs, and loss of consciousness. The headache persisted, with inability to walk, diplopia, and difficulty with speech. Neurological examination revealed a left facial paresis, weakness and ataxia of the left extremities, and dysarthria. The cerebrospinal fluid was grossly bloody, with an initial pressure of 410 mm. of water.

One week later, bilateral common carotid arteriography was carried out, revealing a saccular aneurysm of the right middle cerebral artery just before the bifurcation of the middle cerebral, measuring 6 × 10 mm. in diameter. Findings on the left side were normal. Three days later the right internal carotid artery was ligated with a Selverstone clamp. The clamp was closed completely on the following day. The patient did well clinically after the ligature, but complained of transient pain retro-orbitally and left lower extremity pain.

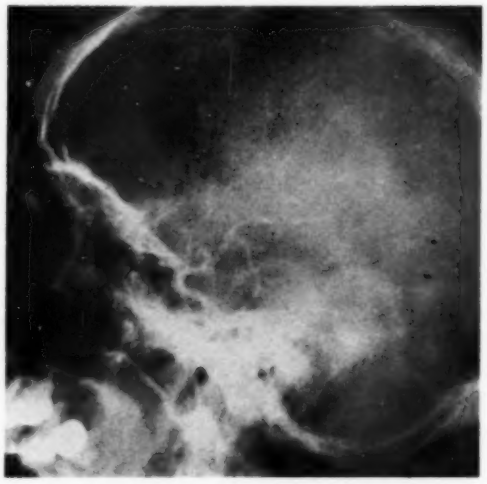

Fig. 3. Case II. Film from postoperative angiographic study made three and a half months following ligation of the right internal carotid artery in the neck. The ophthalmic artery, the carotid siphon, and some branches of the middle cerebral artery are well filled. Note proximal regurgitation below the junction of the ophthalmic artery with the carotid siphon, which is also seen in Fig. 2B.

After three and one-half months the patient returned for repeat arteriography. She was doing well clinically and her only complaints were infrequent mild headaches and minimal weakness of the left hand; there were no sensory disturbances. Right carotid arteriography was performed, with injection of the opaque material proximal to the Selverstone clamp. This revealed good filling of the external carotid artery and all of its branches. The ophthalmic artery was visualized and the opaque material was then visible in the carotid siphon and some of the branches of the middle cerebral artery. Slight retrograde flow of opaque material below the origin of the ophthalmic was noted in the carotid siphon (Fig. 3). The aneurysm was not clearly visualized by this route but was seen when the opposite internal carotid was injected. It was less than half its original size.

CASE III: H. F., a 49-year-old white woman, was admitted to the Neurological Institute on Feb. 28, 1952, because of pain in the right eye and right side of the head of four weeks duration. Five days before admission she noticed, upon awakening, that her right upper lid drooped and she had

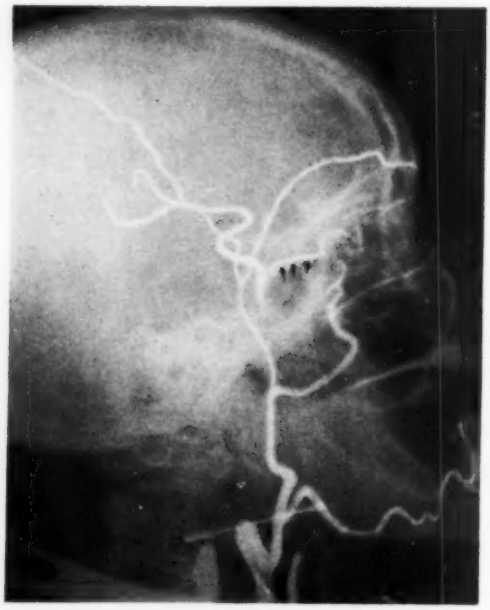

Fig. 4. Case IV. Lateral film of a right carotid arteriogram done by the "cut down" method. The internal carotid artery ends abruptly. The external carotid artery and its branches are well filled. The carotid siphon and the middle cerebral artery and some of its branches are well seen, filled through the ophthalmic artery (arrows). A slight amount of proximal regurgitation is present in the internal carotid artery. Retouched.

diplopia, as well as blurring of vision, in the right eye. Examination revealed complete dysfunction of the right third nerve. Lumbar puncture showed clear fluid. An arteriogram demonstrated a 1.0 × 0.6-cm. aneurysm of the internal carotid artery at the site of origin of the posterior communicating artery. It was decided, after intra-arterial pressure studies, to ligate the internal carotid artery in the neck. This was done by means of a Selverstone clamp, and the patient tolerated the ligation very well.

A postoperative arteriogram was obtained seven months later. This showed occlusion of the internal carotid artery at the clamp and slight filling of the carotid siphon through the ophthalmic artery. No contrast material could be identified in the middle cerebral artery, probably because of dilution. The aneurysm was not visible at this time.

CASE IV: E. J., a 48-year-old colored female, was admitted to the Neurological Institute of New York on Sept. 3, 1943, complaining of drooping of the right eyelid, occasional dizzy spells for the past year, and pain in the right supra-orbital region. Examination revealed a complete right ophthalmoplegia. It was thought clinically that the patient had an aneurysm of the internal carotid artery, and x-ray examination of the skull revealed a pressure erosion of the right anterior clinoid and the margins of the superior orbital fissure on the right side. The right carotid arteriogram showed occlusion of the internal carotid artery in the neck and excellent filling of the external carotid artery and its branches. The ophthalmic artery was larger than average. The middle cerebral artery and some of its branches were well outlined with opaque material even though the portion of the internal carotid artery situated between the point of obstruction and the anterior clinoid process was not visible. It is obvious that the middle cerebral artery filled through the ophthalmic system of anastomosis by way of the external carotid (Fig. 4). This patient suffered from spontaneous thrombosis of the internal carotid artery in the neck, probably brought on by the aneurysm of the intracerebral portion of the internal carotid artery.

COMMENTS

Routine serialograms are indispensable for study of the collateral circulation, since the blood flow is slower through the external carotid artery than through the internal carotid system (3, 4) and is apt to be even slower through collateral channels. In Case I adequate visualization of the internal carotid was not obtained until two seconds following the beginning of the injection, and a single film made on the first injection of Diodrast failed to show the internal carotid artery or any of its branches. The 3 cases included in this report were taken from a series of 13 postoperative arteriograms. These figures tend to indicate that there may be a relatively high incidence of collateral circulation through the ophthalmic artery following ligation of the internal carotid artery in the neck, although the number of cases is still insufficient for the drawing of any conclusions. In Cases I, II, and IV there was substantial filling of the middle cerebral branches to a degree that leaves no doubt as to the importance of the contribution to the circulation of this hemisphere made by the external carotid. In Case III the filling was much less marked. It should be stated that in no case was compression of the opposite carotid artery made while the serialograms were taken.

The time elapsed between ligation and postoperative arteriography did not seem to influence the amount of collateral circulation through the ophthalmic artery. In Case III, the one which showed least retrograde filling, re-examination was done seven months after ligation, whereas in Cases I and II the interval was only four and three and a half months respectively.

In none of the 4 cases included in this report did contrast material outline the anterior cerebral artery; only the middle cerebral and its branches were visualized. It is presumed that the blood flow in the homolateral anterior cerebral artery is supplied by the opposite anterior cerebral artery.

The lumen of the intracranial portion of the internal carotid artery does not become obliterated after operative ligation nor in all instances of spontaneous thrombosis of the internal carotid artery in the neck. This observation is confirmed by the fact that some regurgitation of the contrast material proximal to the entrance of the ophthalmic artery was seen in 3 of our cases (I, II, and IV). Proximal regurgitation is also seen when collateral circulation is established through the anterior and posterior communicating arteries; it was observed by Torkildsen and Koppang in the latter type of case and attributed by them to the "suction action" of the ophthalmic artery, drawing the blood above the junction with the internal carotid and thereby permitting the contrast material coming from the other side to pass below the bifurcation. In our cases a possible explanation for this phenomenon of retrograde filling is that injection of the contrast material is perhaps made at a pressure higher than that of the blood. The latter is a controversial point which has not been clarified. Because of this possible momentary rise of pressure during the injection, we cannot assume that the brain actually receives as much blood through the ophthalmic system of anastomosis as is demonstrated on the films. Only in Case I (Fig. 2, A and B) can we assume that the ophthalmic artery must be carrying a large amount of blood because it became two or three times larger on the films after ligation and because of the unusually good filling of the intracranial arteries.

It would be of great interest to repeat the experiences of Shenkin *et al.* concerning the relative contribution of the internal and external carotid arteries to the circulation of the brain in a series of patients following ligation of the internal carotid artery in the neck.

SUMMARY

Four cases in which external-internal carotid anastomosis through the ophthalmic artery has been demonstrated arteriographically are discussed.

Three of these cases were taken from a series of 13 arteriograms following ligation of the internal carotid artery in the neck for intracranial aneurysm and 1 case was a spontaneous thrombosis of the extracerebral portion of the internal carotid. The importance of serial films is emphasized.

ADDENDUM

Since this paper was submitted for publication, 5 additional cases (out of 23) of spontaneous thrombosis of the internal carotid artery in the neck with retrograde flow through the ophthalmic artery have been seen at the Neurological Institute. We have come to regard ophthalmic filling as a reliable sign of thrombosis as against a possible error, *i.e.*, injection of the opaque medium into the arterial wall. In 10 additional cases post-ligation angiography has been performed and in 2 of these retrograde flow through the ophthalmic into the internal carotid artery was observed.

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SUMARIO

Observación Arteriográfica de la Anastomosis de las Carótidas Externa-Interna a Través de la Arteria Oftálmica

En 4 casos en que se tomaron arteriogramas varios meses después de la oclusión de la carótida en el cuello, fué posible observar anastomosis entre las carótidas externa e interna por vía de la arteria oftálmica. Tres de estos casos fueron descubiertos en una serie de 13 estudios arteriográficos consecutivos a ligadura de la carótida interna en el cuello por aneurisma intracraneal. El cuarto enfermo tenía una trombosis espontánea radicada de la porción extracerebral de la carótida interna.

Para descubrir la circulación colateral resulta indispensable tomar radiografías corrientes en serie.

Unsuspected Superior Vena Caval Obstruction Detected by Angiocardiography

Report of a Case[1]

ALPHONZO JORDAN, M.D.,[2] JOHN W. LAWLAH, M.D., JOHN B. JOHNSON, M.D., and ANDREW F. BURTON, M.D.

ANGIOCARDIOGRAPHY is rapidly becoming a routine method for adequate evaluation of upper mediastinal lesions and has increased significantly the accuracy of diagnosis of mediastinal masses. We report here a case of superior vena caval obstruction which was totally unsuspected clinically. This case takes on added interest since our examinations established the fact that the obstruction to the superior vena cava extended to below the opening of the azygos vein into the superior vena cava, and also that there was obstruction of the left innominate and right subclavian veins.

B. S., a 76-year-old Negro female, entered the hospital Nov. 18, 1951, because of a superior mediastinal mass. She had become ill in December 1950, at which time anorexia occurred and she began to lose weight. In July 1951, she began to experience pain, varying in location from the upper right and left parasternal region of the chest to the left side of the neck. This was thought to be precipitated by eating but not by walking. Roentgen examination of the chest on Oct. 10, 1951, by a private physician, revealed a mass in the upper right mediastinum. An admission chest film confirmed this finding (Fig. 1).

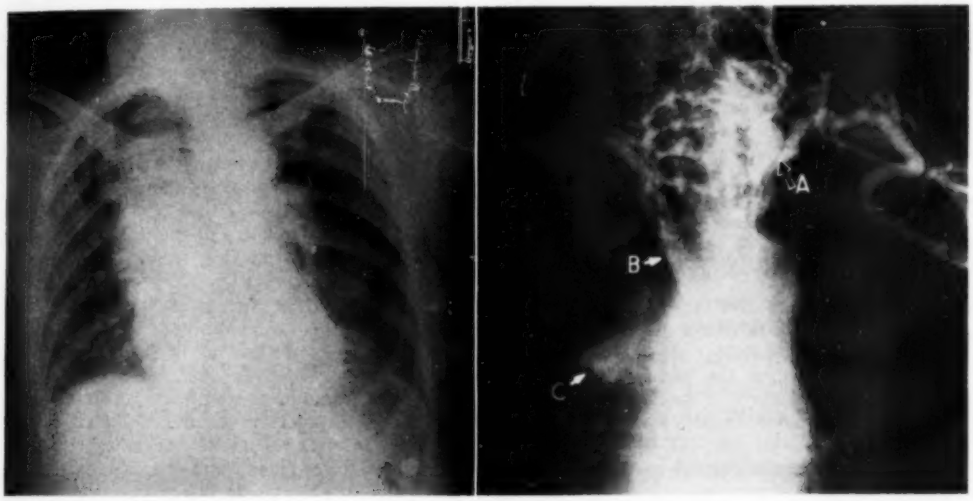

Fig. 1 (left). Admission chest film, showing mass in upper right mediastinum (A), previously reported by the patient's private physician.

Fig. 2 (right). Frontal angiocardiogram at one second, demonstrating the point of obstruction of the left innominate vein (A), the right superior intercostal (B) and the point of obstruction of this vessel at the superior vena cava (C).

Physical examination revealed evidence of weight loss. A slight bulge was present on the right side of the sternum, where dullness and tenderness were elicited. There were no pulsations. The point of maximum impulse of the heart was in the

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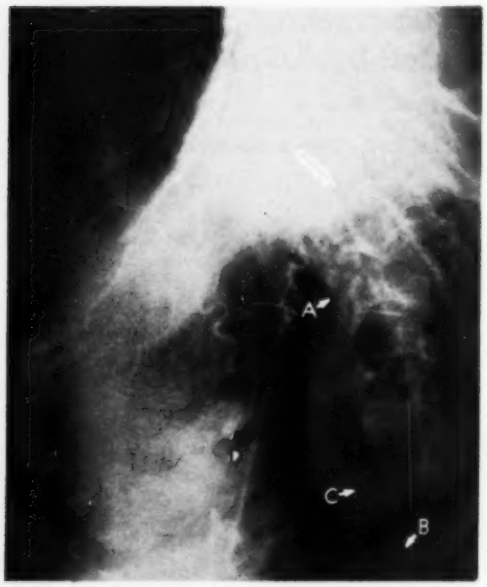

Fig. 3. Left anterior oblique angiocardiogram taken at two seconds, demonstrating the right superior intercostal (A), the azygos minor inferior (B), the azygos major (C), and the point of obstruction where these vessels empty into the superior vena cava (D).

sixth intercostal space, just to the left of the midclavicular line. The rhythm was regular, with infrequent premature beats; A_2 was louder than P_2. The remainder of the physical examination was essentially negative. Especially striking was the absence of venous distention in the arms and chest.

The temperature was normal, pulse 108, respirations 20. The blood pressure was 160 systolic and 80 diastolic. Venous pressure was 210 mm. H_2O in the right arm and 260 mm. H_2O in the left arm.

The urine had a specific gravity of 1,012, and was negative for albumin and glucose. The sediment contained a few pus cells, epithelial cells, and bacteria. Examination of the blood revealed: hemoglobin, 8.6 gm.; red cells, 2,830,000; hematocrit, 29 per cent; white cells, 5,450, with a normal differential count. The total protein was 8.45 gm. per cent; albumin 3.47 gm. per cent; globulin 4.98 gm. per cent. The non-protein nitrogen was 22 mg. per cent, the fasting blood glucose 77 mg. per cent, and the chlorides 101 mEq./L. A blood Wassermann test was negative. The electrocardiogram was suggestive of myocardial damage. An esophagogram and a gastrointestinal series were normal. Fluoroscopic examination of the chest revealed a non-pulsating mass in the right anterior superior mediastinum. The heart was enlarged slightly in the region of the left ventricle.

The patient was given blood transfusions and supportive treatment until the hemogram approached normal, at which time she was referred to the Cardiovascular Research Laboratory for angiocardiographic studies.

The first angiocardiograms were taken on Nov. 20, 1951, using a left antecubital vein. The arm-to-tongue circulation time was fourteen seconds with calcium gluconate. Following the injection of 50 c.c. of 70 per cent Diodrast, postero-anterior views were obtained at one, four, and five seconds and at one-second intervals from ten through fourteen seconds. Left anterior oblique projection films were taken at one through eight seconds, at one-second intervals. A review of the films revealed a complete obstruction to the left innominate vein at its proximal end and extensive collateral circulation across the lower cervical and upper dorsal spine. The right superior intercostal and the azygos major were blocked at the point where they empty into the superior vena cava, causing the Diodrast to go in a retrograde direction through the azygos system, to enter into the heart through the inferior vena cava. Figures 2 and 3 demonstrate the significant points.

In view of the above findings, and since the arm-to-tongue circulation time on the right was twelve seconds (two seconds less than on the left), it was thought that better filling of the right heart might be obtained with injection from the right side. On Dec. 11, angiocardiography was done using an antecubital vein of the right arm, films being obtained in the postero-anterior projection from one through six seconds at half-second intervals. These films revealed an obstruction to the right subclavian vein and showed many collateral vessels in the right supraclavicular area. The right intercostals were opacified, as well as the right superior intercostal, azygos major and azygos minor inferior. The point of obstruction where the azygos major and the right superior intercostal empty into the superior vena cava was clearly seen. Figure 4 shows these angiocardiographic findings.

Since the superior vena cava was shown to be completely obstructed and the patient experienced little difficulty with the examination, we proceeded to study the functional state of the inferior vena cava on Dec. 29, by injection of 50 c.c. of 70 per cent Diodrast into the left femoral vein. The circulation time was twelve seconds. Films were taken from one through twelve seconds at one-second intervals. For the first time adequate visualization of the cardiopulmonary circulation was obtained. The films revealed a suggestive dilatation of the inferior vena cava. The tumor was shown to be non-vascular and not to obstruct or cause a deformity of the right pulmonary artery or the ascending aorta.

On Jan. 11, 1952, a bronchoscopic examination showed the carina shifted slightly to the left. The right main bronchus was slightly indurated and stenotic immediately proximal to the division of

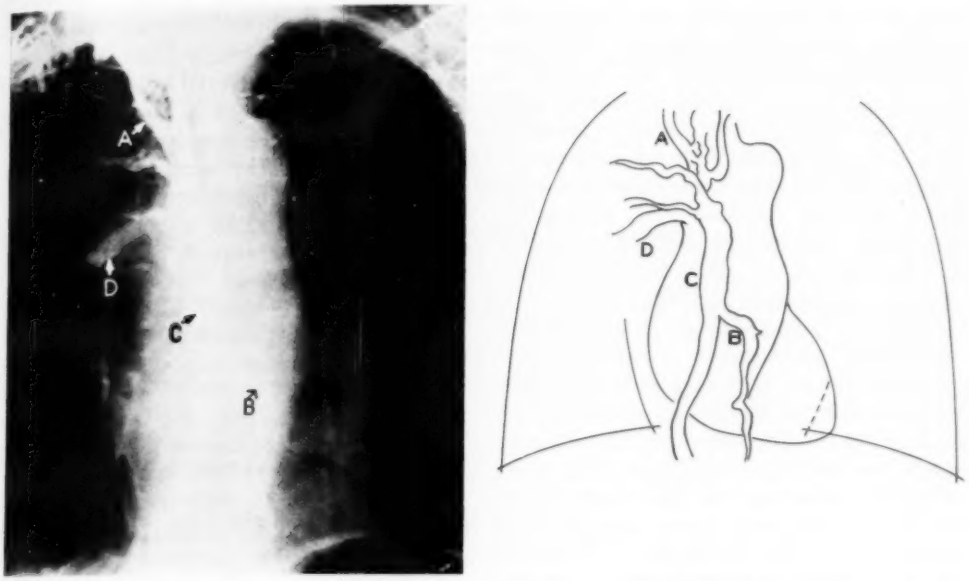

Fig. 4. Frontal angiocardiogram following injection into the right antecubital vein, demonstrating the right superior intercostal (A), the azygos minor inferior (B), azygos major (C), and the point of obstruction where these vessels empty into the superior vena cava (D).

the middle bronchus. Circumferential thickening of the mucosa was noted, with fresh hemorrhage on the floor of the main bronchus. Because of further hemorrhage the examination was not completed.

On March 27, a thoracotomy revealed a tumor just under the right anterior ribs. Biopsy showed it to be a reticulum-cell sarcoma. The patient was referred for x-ray therapy but unfortunately left the hospital prior to receiving any treatment. She died within three months following operation. Autopsy was not obtained.

DISCUSSION

The clinical diagnosis of superior vena caval syndrome resulting from obstruction to the superior vena cava is made without difficulty where classical findings are present. Numerous reports give proof that the condition is a well established clinical entity. An excellent review of the literature has been recently made by McIntire and Sykes (1). Hussey, Katz, and Yater (2) in their report of 35 cases (1946) also give an excellent picture of the typical findings.

The clinical picture of obstruction of the superior vena cava is dependent upon the acuteness of the process, as well as the location of the obstruction. Since our patient failed to show the classical clinical picture of superior vena caval syndrome, it is suspected that the obstruction was gradual in onset, so that there was adequate time for collateral circulation to develop. It is of interest that the innominate vein on the left and subclavian on the right were also obstructed, thereby preventing collateral circulation through the internal mammary veins. This would not have been the case in obstruction of the superior vena cava alone. The azygos vein was obstructed at the point where it emptied into the superior vena cava, thereby causing the blood to take a retrograde course, eventually to enter the heart through the inferior vena cava. Had the vena caval obstruction been above this point, the blood would have been able to enter the heart through the superior vena cava. The absence of markedly dilated veins on the anterior chest is explained in part by the fact that most of the collateral vessels were posterior.

Since tumor or aneurysm is present in from 75 to 85 per cent of cases of obstruction to the superior vena cava and, since

there was no suggestion whatever of an aneurysm in routine chest films or in the angiocardiographic films, we suspected that a malignant tumor of some type would be found. The right pulmonary artery was not involved because the tumor was anterior to that vessel and, although there was no evidence of aortic involvement, we suspected that the tumor lay against its anterior aspect without causing compression or infiltration.

We can only speculate as to whether the obstruction of the left innominate and right subclavian vein was due to thrombosis resulting from stasis secondary to obstruction to the superior vena cava or to external compression by the sarcoma or retrograde extension of the tumor inside the veins, plugging these vessels with tumor tissue. The development of thrombosis secondary to stasis seems to be the most plausible explanation.

SUMMARY

A case of unsuspected superior vena caval obstruction detected by angiocardiography is reported. The obstruction extended to below the opening of the azygos vein into the superior vena cava and there was concomitant obstruction of the left innominate and right subclavian veins. The known duration of the tumor was less than two years. It is reasonable to assume, however, that it had existed for a long time prior to discovery, in view of the extensive collateral circulation.

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SUMARIO

Insospechada Oclusión de la Vena Cava Superior Descubierta por la Angiocardiografía. Presentación de un Caso

Preséntase un caso de insospechada oclusión de la vena cava superior descubierta por la angiocardiografía. La oclusión se extendía hasta más abajo de la desembocadura de la vena ácigos en la cava superior, y había oclusión concomitante del tronco venoso braquiocefálico izquierdo y de la vena subclavia derecha. La duración conocida del tumor no llegaba a dos años. Sin embargo, es lógico suponer que había existido desde mucho antes de descubrirlo, dada la extensa circulación colateral ya presente en el primer examen angicardiográfico.

Bleeding Lesions of the Gastrointestinal Tract in Infants and Children[1]

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BLEEDING FROM the alimentary tract is an important manifestation of significant disease in all age groups but particularly so in infants and children. Although the astute pediatrician often is able to suggest accurately the source of the blood as a result of careful evaluation of history and physical findings, the roentgen examination is of great value in providing information concerning the exact location and appearance of any lesion. The roentgenologist, therefore, is directly concerned with the causes of gastrointestinal bleeding in infants and children and the relative frequency of lesions producing it.

The incidence of disease differs not only between adults and children but in children of various ages from birth to fifteen years. Conditions occur in infancy that are not seen in older children and adults.

In order to classify the causes of bleeding from the alimentary tract, we first reviewed the case records and roentgenograms of all infants and children seen at the Mayo Clinic in a five-year period with gastrointestinal conditions that might cause gross bleeding. Our findings indicate that bleeding is a fairly common sign of gastrointestinal disease in children, being present in approximately 50 per cent of the series reviewed. This percentage, however, is undoubtedly high, since the cases selected for study were those in which bleeding was thought likely to occur. The 246 cases in which bleeding from the gastrointestinal tract was encountered form the basis of this report. All cases of bleeding from hemorrhoids, anal fissure and anal abrasion, as well as from the mouth and nose, were excluded. Since this report deals only with those cases in which gross blood was present, cases of anemia due to occult bleeding were also excluded. This selection seemed necessary because anemia is so often due to disease not directly involving the gastrointestinal tract.

CAUSES OF BLEEDING

The causes of bleeding from the gastrointestinal tract in this group of 246 cases are listed in Table I. The most common cause of bleeding in infants and children in our experience is chronic ulcerative colitis. This condition and polyps of the colon, which are next in importance, were responsible for gross bleeding in more than 50 per cent of our cases. Infants and children are more likely to bleed from the rectum than to vomit blood. In 19 cases the source of hemorrhage was not found. Meckel's diverticulum and intussusception were responsible for 17 cases each, while varices of the esophagus, duodenal ulcer, leukemia, mesenteric lymphadenitis, volvulus and regional enteritis acted as the cause of bleeding in a smaller proportion. The remaining cases were due to a variety of lesions (Table I).

Brayton and Norris (1), in a similar study, classified bleeding from gastrointestinal lesions as primary when from a polyp, Meckel's diverticulum, or other such lesion, and secondary when due to a condition such as intussusception or leukemia. They concluded that in the

[1] Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.
[2] The Mayo Foundation is a part of the Graduate School of the University of Minnesota.

TABLE I: CAUSES OF BLEEDING IN 246 INFANTS AND CHILDREN

	Total	Age in Years — Group I Under 2	Group II 2–6	Group III 7–15
Chronic ulcerative colitis	94	1	12	81
Polyps of colon	40	..	31	9
Cause undetermined	19	4	10	5
Meckel's diverticulum	17	6	8	3
Intussusception	17	14	3	..
Varices of esophagus	10	..	4	6
Duodenal ulcer	8	..	4	4
Blood dyscrasias	11	3*	4†	4‡
Mesenteric lymphadenitis	5	..	4	1
Volvulus	6	5	1	..
Regional enteritis	5	..	1	4
Jejunal polyps	1	..	..	1
Gastric ulcer	1	1	..	..
Gastroenteritis	2	1	1	..
Lymphosarcoma of ileum	1	..	..	1
Foreign body in esophagus	1	1	..	..
Meningitis	2	2	..	..
Hemorrhagic disease of newborn	2	2	..	..
Carcinoma of rectosigmoid	1	..	..	1
Acute enteritis	2	..	2	..
Ileal band	1	1	..	..
TOTAL	246	41	85	120

* One case each of unclassified blood dyscrasia, aplastic anemia and thrombocytopenic purpura.
† Leukemia in all 4 cases.
‡ Leukemia in 3 cases; Henoch's purpura in 1.

majority of instances bleeding from the alimentary tract during infancy and childhood is incidental to diseases diagnosed from other more specific symptoms and findings. In our experience, the roentgenologist participates actively in the diagnosis of about 90 per cent of bleeding lesions of the alimentary tract in these young patients.

Certain differences in the etiology of hemorrhage are apparent among children of various ages. For that reason we classified our cases, on the basis of age, into three groups: Group I, in children of less than two years; Group II, two through six years; Group III, seven through fifteen years. The causes of bleeding in each age group are listed in Table I. They will be considered, along with the roentgenologic aspects, for each group.

Group I, Less than Two Years: In children less than two years, the most common cause of bleeding was intussusception (Table I). This condition is found almost entirely in infants. The roentgenologic diagnosis is usually not difficult and is easily established with the aid of a barium enema, except in those instances in which the intussusception is ileo-ileal in nature. In such cases the roentgen diagnosis is usually intestinal obstruction, and evidence for this diagnosis may be obtained from a scout (preliminary survey) film of the abdomen.

Next in order of frequency as causes of bleeding in Group I were Meckel's diverticulum and volvulus. Volvulus was almost always associated with some anomaly of rotation of the intestine. The diagnosis should be suspected whenever a scout film gives evidence of intestinal obstruction. Successful roentgen diagnosis of Meckel's diverticulum in infants of one year or less has not been easy. Technical difficulties encountered in examination of the small intestine probably have been the chief reason for this. If procedures and equipment were not so difficult to use in these young patients, the roentgenologist might make a much more valuable contribution.

A diagnosis of gastric ulcer was suggested roentgenologically only once in our entire series, the patient being in this age group. The number of cases is small, however, and a roentgenologic diagnosis of peptic ulcer in infants is not easily established. Such ulceration has been reported to be gastroduodenal in location, with a preponderance of the ulcers being gastric in origin. The diagnosis may be suspected from such complications, as perforation and hemorrhage. Roentgen demonstration of the ulcer crater is difficult because of inability of the examiner to palpate the stomach and duodenum adequately. The stomach is small and highly placed and infants are generally unco-operative, particularly if feeding has been withheld. Necropsy findings indicate that the ulcer may be very small and superficial, in which event it may be practically impossible to demonstrate the crater roentgenologically. Perhaps the condition listed in Table I as hemorrhagic disease of the newborn may actually have been peptic

ulcers which could not be visualized on roentgen examination (2). At necropsy serial sections are sometimes necessary to show an ulcer which is not apparent by inspection of the duodenum. The 2 cases of upper gastrointestinal bleeding associated with purulent meningitis occurring in patients in Group I may also have been instances of peptic ulcer.

Blood dyscrasias of various types were rather prominent in producing gastrointestinal bleeding in infants. Chronic ulcerative colitis is unusual in this age group, and the gastric ulcer previously mentioned occurred in the presence of duplication of the stomach (Fig. 1). The ulcer was in the inner stomach and was eroding into the outer stomach

In 4 infants in Group I the cause for bleeding could not be found. Two had tarry stools and 2 had blood-streaked stools. None of the 4 were treated by exploratory operation, and none had any recurrence of the bleeding after the initial episode.

Group II, Two through Six Years: In children two through six years of age, the most common source of bleeding was polyps of the colon (Table I), representing about 37 per cent of all cases in this age group. Next in order of frequency was chronic ulcerative colitis, which accounted for 14 per cent. Bleeding for which no cause could be found occurred in a proportionately larger number of children in Group II than in the other two groups. In all such cases, the bleeding was rectal. Exploratory operation was performed in 5 of the 10 indeterminate cases (in 1 case twice) without revealing the source of the hemorrhage. Roentgenologic studies of the gastrointestinal tract in these 5 cases had given negative results.

Meckel's diverticulum is a fairly frequent source of bleeding. It was found on exploration to be responsible for a little less than 10 per cent of the cases in Group II. We were no more successful in demonstrating Meckel's diverticulum by roentgenologic means in this age group than in infants.

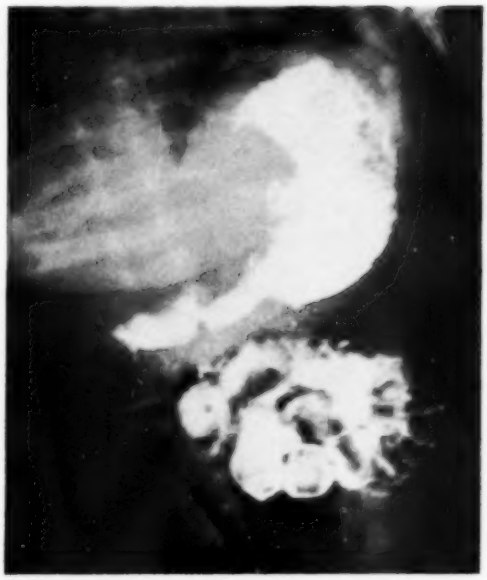

Fig. 1. Roentgenogram of the stomach of a 3-month-old boy, showing a large gastric ulcer on the lesser curvature.

Duodenal ulcers were found in 4 patients two through six years of age. The roentgenologic appearance seemed to resemble the ulceration seen in adults more than that described in infants. Roentgen demonstration of duodenal ulcer is made difficult by frequent inability to obtain adequate distention of the duodenal cap. One is generally able to express barium from the stomach into the duodenum but often not in an amount sufficient to distend the latter. Scars and craters may be small, and diagnosis without complete distention of the duodenal cap is unsatisfactory. Adequate palpation of the stomach and cap may be difficult because they frequently are highly placed in the abdomen.

Blood dyscrasias did not cause gastrointestinal bleeding often in our series of cases. Bleeding associated with leukemia is usually terminal; in all the cases of leukemia described by Brayton and Norris death occurred within thirty days of the episode of bleeding and in most instances the interval was very short.

The diagnosis of mesenteric lymphadenitis was made by exploration of the

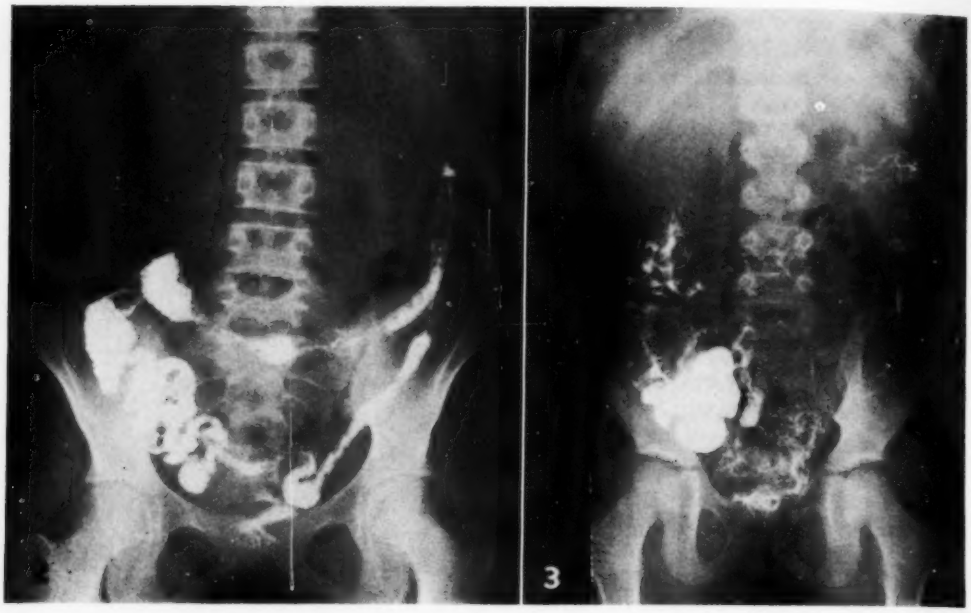

Fig. 2. Post-evacuation roentgenogram of colon of a 14-year-old child, with shortening, narrowing, and loss of mucous membrane relief pattern in the entire colon. These are the characteristic roentgen changes of advanced chronic ulcerative colitis.

Fig. 3. Early changes of chronic ulcerative colitis manifested roentgenologically by involvement of the mucous membrane relief pattern in the post-evacuation film.

abdomen when the site of the bleeding could not be determined by roentgenologic procedures. No causal relationship between enlarged mesenteric lymph nodes and bleeding has been established and, since these lymph nodes are normally larger in children, this diagnosis is not satisfactory as an explanation for bleeding. It may be that such cases belong with those in which no cause of bleeding could be found.

Esophageal varices in children may cause rather severe hemorrhage. The roentgenologic appearance consists of filling defects in the lower portion of the barium-filled esophagus produced by the distended veins. Roentgen diagnosis is either obvious or extremely difficult. In our experience the diagnosis is easier in the older child and when the varices have been present for some time. In younger children with small lesions, the filling defects may be extremely difficult to see, even though esophagoscopy has revealed the varices. Possibly the vessels are so thin-walled and easily collapsible that the pressure of a swallow of barium flattens them and they temporarily remain that way.

Because the lower age limit in this group was two years, a few patients with intussusception or volvulus are included. These conditions are unusual in older children and probably belong in the infant group as a cause of bleeding. Two patients in Group II had acute enteritis characterized by severe diarrhea and 1 had regional enteritis, all with some bleeding.

Group III, Seven through Fifteen Years: The cause of gastrointestinal bleeding in the majority of children from seven through fifteen years was chronic ulcerative colitis (Table I). Its incidence seems to be entirely out of proportion to that of other diseases responsible for bleeding. This unusual situation may be partially explained by the fact that a large number of patients with ulcerative colitis are referred to the Clinic and also by the fact that almost 100 per cent of patients with

the disease have gross bleeding. The roentgen diagnosis of chronic ulcerative colitis is not difficult when the condition is moderately or far advanced and narrowing, shortening, and thickening of the intestine are obvious (Fig. 2). Its early roentgenologic recognition, however, is based on the demonstration of minor alterations in the mucosal pattern of the colon; such alterations are best seen in post-evacuation films (Fig. 3).

The ease of roentgenologic diagnosis is usually directly proportional to the age of the patient. The younger children in this age group usually are not as well prepared for examination as the older ones. Often small children will evacuate only the barium contained in the rectum. The retained barium in the rest of the colon, together with unsuccessful preparation, makes the early roentgen diagnosis of chronic ulcerative colitis extremely difficult. Castor oil and enemas seem to be consistently more effective in adults than in children, which would account for the higher proportion of poorly prepared children. The reason for the variation in effectiveness of such preparation in children is not clear.

Satisfactory roentgenograms are not obtained easily without some form of restraint, and this is difficult to accomplish when adults and children are being examined together. Problems of a technical nature are more easily solved when one is dealing with children alone.

Many of the problems of roentgenologic diagnosis of chronic ulcerative colitis are also manifest in the diagnosis of polyps of the colon. Unsatisfactory air studies of the colon are generally due to inadequate evacuation, and our experience has been that satisfactory roentgenograms are much more difficult to obtain than for adults. Polyps are a fairly frequent cause of intestinal bleeding and a high percentage of polyps bleed (Fig. 4).

Next in order of frequency as a source of gastrointestinal bleeding in Group III were varices of the esophagus. These were much more easily demonstrated roentgenologically in this older age group than in the younger children, and the incidence was slightly higher than for bleeding from duodenal ulcer. It is likely that a much higher percentage of varices than duodenal ulcers will bleed.

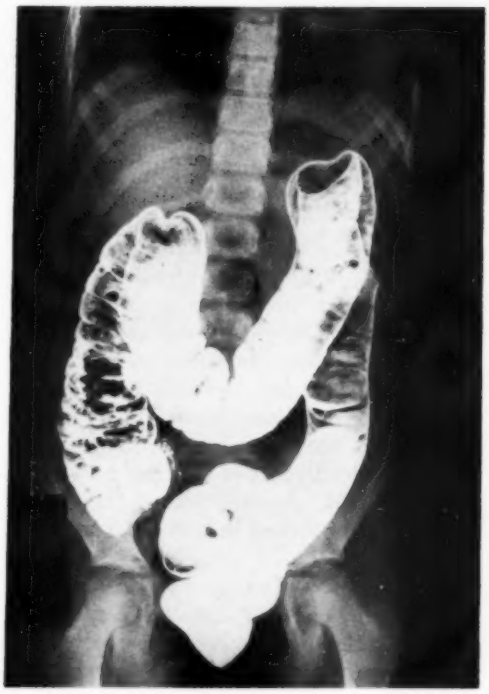

Fig. 4. Roentgenogram of the colon of an 8-year-old girl, revealing numerous polyps.

The roentgen findings of regional enteritis and duodenal ulcer in Group III closely resemble those for adults. It is apparent, even in this small series, that duodenal ulcer causes bleeding in a fairly high percentage of cases. In our experience a little less than 25 per cent of duodenal ulcers in infants and children bled. The characteristic duodenal deformities and craters, which are the roentgenologic manifestations of ulcer, are relatively easy to demonstrate in older children. Regional enteritis is not too rare in children and frequently will cause bleeding. The roentgen picture is the same as in adults, consisting of loss of normal pattern of the mucous membrane and thickening and narrowing of the intestine.

The percentage incidence of bleeding for which no cause could be found was lower in this age group than in the other two. The source of bleeding was not determined in 5 patients (4 per cent). Of these 5 patients, 2 had exploratory operations and no cause for the bleeding was determined. The higher percentage of unexplained bleeding in Group II (about 11 per cent) may be due either to a greater tendency to bleeding in this age group or inability of the roentgenologist to demonstrate the source of bleeding, possibly to both.

Blood dyscrasias, including leukemia, were not a prominent cause of intestinal bleeding in our experience with children seven to fifteen years of age, nor was bleeding from the gastrointestinal tract frequently encountered in our cases of blood dyscrasia.

In our review of cases of gastrointestinal lesions which might cause bleeding, we found 9 cases of neoplastic disease of the large and small intestine but none of the esophagus and stomach. Only 2 of the 9 patients gave a history of bleeding: 1 of these had a carcinoma of the rectosigmoid colon and the other a lymphosarcoma of the ileum. Both were in Group III. We did not find any instance of ulcerated benign intestinal tumor. Mesenteric lymphadenitis, described more frequently in younger age groups, was seen in only 1 case in Group III, and Meckel's diverticulum, which appeared with greater frequency in Group II, was responsible for bleeding in only 2 children seven to fifteen years of age. There was 1 case of jejunal polyposis.

COMMENT

Roentgenologic diagnosis of bleeding lesions of the gastrointestinal tract in children more than six years of age is usually reliable and accurate and, except in a few instances, the lesions producing the bleeding closely resemble those of adults.

The problem of localization of gastrointestinal bleeding in patients less than seven years old offers a challenge to the diagnostic roentgenologist. Exchange of ideas on how best to overcome the technical problems and familiarity with the causes of hemorrhage may increase the value of the roentgenologic examination in locating the source of bleeding from the alimentary tract.

SUMMARY

The most common causes of bleeding from the gastrointestinal tract in 246 infants and children seen at the Mayo Clinic were chronic ulcerative colitis, polyps of the colon, Meckel's diverticulum and intussusception. The source of the bleeding was undetermined in 19 cases.

In this series the most common cause of gastrointestinal bleeding from birth through one year of age was intussusception; from two through six years of age, polyps of the colon; from seven through fifteen years, chronic ulcerative colitis.

Some of the problems of roentgenologic diagnosis of these and other causes of gastrointestinal bleeding in infants and children are discussed.

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SUMARIO

Lesiones Hemorrágicas del Tubo Gastrointestinal en Lactantes y Niños

El diagnóstico roentgenológico de las lesiones sangrantes del tubo gastrointestinal en niños de más de seis años suele ser fidedigno y exacto y, salvo en algunos casos, las lesiones que producen la hemorragia se parecen mucho a las de los adultos.

La localización de la hemorragia gastrointestinal en enfermitos de menos de siete años plantea un problema más grave y lanza un reto al roentgenólogo diagnosticador, debido en gran parte a las dificultades técnicas creadas por el examen de pacientes tan jóvenes.

Las causas más frecuentes de hemorragia del tubo gastrointestinal en 246 lactantes y niños observados en la Clínica Mayo fueron colitis ulcerativa crónica, pólipos del colon, divertículo de Meckel e invaginación. En 19 casos, no se determinó la causa. En esta serie, la causa más común de la hemorragia desde el nacimiento hasta la edad de un año inclusive fué invaginación; desde el segundo hasta el sexto año inclusive, pólipos del colon; de los siete a los quince años, colitis ulcerativa crónica. Discútense algunos de los problemas planteados por el diagnóstico radiológico de estas y otras causas de hemorragia gastrointestinal en lactantes y otros niños.

Ileo-Ileal Intussusception in a Child[1]

A Case Report

STUART P. BARDEN, M.D.

INTUSSUSCEPTION of the small and large bowel in infants and children has been well documented. The gratifying decrease in mortality in the past fifteen years is a tribute to the increasing alertness of physicians, to improvement in surgical technic and speed in preparing the patient for operation, and to the technic of reducing large bowel intussusceptions by retrograde hydrostatic pressure, especially by barium enema under direct fluoroscopic observation.

Although numerous cases have been reported in which both the intussusceptum and intussuscipiens involved the small bowel only, film demonstrations of this particular situation are uncommon. A case of ileo-ileal intussusception is recorded here, originating in a Meckel's diverticulum and preceded by Henoch's purpura, in a child of two.

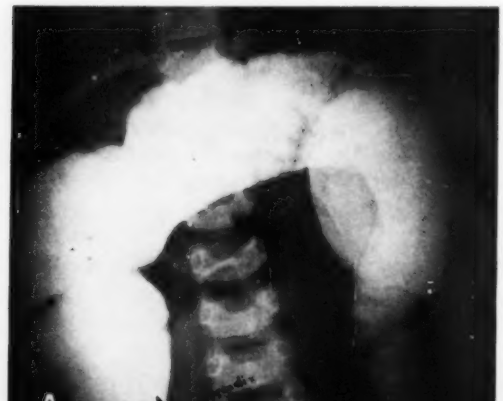

Fig. 1. The colon is filled with barium. The appendix (A) and cecum are identified, and the palpable mass (B) is seen medial to the cecum. Dilated loops of small bowel are present. This film eliminates the colon as the site of mechanical intestinal obstruction.

Fig. 2. The barium has flowed refluxly into the terminal ileum. Note the cup-shaped deformity of the intussuscipiens (A) outlined faintly by barium. The non-opaque mass producing this deformity is the intussusceptum (B).

P. R., a 2-year-old white girl, was under frequent observation and treatment by a pediatrician for Henoch's purpura. Mild associated gastrointestinal bleeding had been a minor sign of the condition. At 3:00 A.M. on June 12, 1953, the child awoke suddenly, screaming with pain in the abdomen. Characteristically she doubled-up and pulled up her knees with each cramp. At 8:30 A.M. the same morning, she was brought to the Department of

[1] Accepted for publication in September 1953.

Radiology under heavy sedation, with a request for barium enema examination, intussusception suspected.

Abdominal examination prior to starting the barium enema revealed a mass, the size of an orange, in the suprapubic area. This mass was slightly mobile and felt like grouped loops of bowel.

As the course of the barium enema was observed during fluoroscopy, the entire colon filled and the appendix was identified. The palpable mass was separate from the colon. A small amount of air was then introduced through the enema tubing, and reflux of barium occurred into the ileum. This flowed without obstruction for 6 to 8 inches. At this point the cup-shaped deformity of intussusception was identified in relation to the palpable mass. Much of the barium enema was siphoned back.

Surgery was performed under Avertin cyclopropane anesthesia at noon, nine hours after symptoms first appeared. The report of the surgeon, R. A. Stiefel, M.D., reads as follows:

"A lower mid-line incision was made. On opening the abdomen there was a considerable quantity of straw-colored fluid in the peritoneal cavity. This was removed with suction. The mass which was palpable preoperatively just below the umbilicus was brought into the wound and identified as ileum. Proximally, there was an ileo-ileal intussusception with definite gangrene of the outer segment of the ileum for a distance of about 1 1/2 feet. The intussusception was reduced by milking it from the proximal end toward the distal end. The inner segment was also gangrenous for a distance of about 1 1/2 feet. In the mid-portion of the inner segment was a Meckel's diverticulum which was also intussuscepted and was undoubtedly the origin of the process. None of the gangrenous looking bowel returned to normal color with hot packs. The resection of the entire segment amounted to about 3 feet of ileum. This was carried out and an end-to-end aseptic anastomosis performed. The remaining mesenteric fold was approximated with interrupted sutures. In order to peritonealize the surface, the abdomen was closed without drainage after inserting 2 gm. of Neomycin into the abdominal cavity. A Miller-Abbott tube was inserted into the stomach immediately postoperatively. The patient left the operating room in good condition."

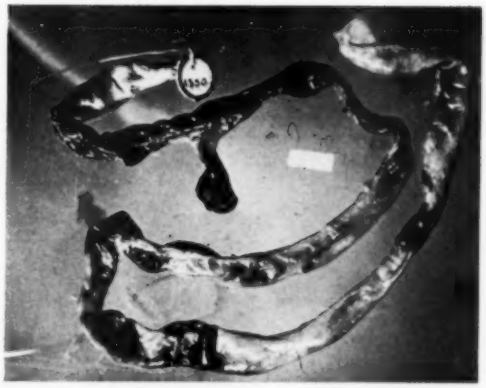

Fig. 3. Photograph of the surgical specimen consisting of 3 feet of resected ileum. The dark areas are produced by gangrene. The Meckel's diverticulum is well identified.

The postoperative course was long and stormy. The child now is alive two months after surgery, although a pelvic abscess developed, which has resorbed slowly. Bowel function is occasionally abnormal, and intermittent, apparently incomplete intestinal obstruction continues to threaten frequently.

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SUMARIO

Invaginación Ileo-Ileal en un Niño. Presentación de un Caso

Descríbese un caso de invaginación íleo-ileal en un niño de tres años, que padecía de púrpura de Henoch. Un estudio con enema de bario eliminó el colon como sitio de la oclusión y reveló la deformidad caliciforme de la porción intususcipiente. Se operó a las nueve horas de la iniciación de los síntomas y el niño se hallaba vivo dos meses después.

En la porción media del segmento gangrenoso resecado de intestino había un divertículo de Meckel, que estaba también invaginado y que era sin duda el origen del proceso.

Healing Mechanisms of Tuberculous Cavities[1]

M. B. HERMEL, M.D., and J. GERSHON-COHEN, M.D.

TUBERCULOUS CAVITIES probably represent the most important feature of pulmonary tuberculosis. Without cavitation, tuberculosis can be a benign disease; with cavitation it must be regarded as a serious and progressive malady. Closure of cavities is the primary aim of all forms of medical and surgical therapy. An understanding of the mechanisms whereby tuberculous cavities heal promotes a better grasp of the roentgen manifestations of such healing. This in turn facilitates the handling of the individual patient. The following cases, culled from a large material at the Eagleville Sanatorium, Eagleville, Penna., and from private practice, serve to illustrate the important mechanisms in cavity closure.

Tuberculous cavities heal by two general processes, open and closed, the particular designation depending upon the status of the draining bronchus (4). In the open form of healing the lumen of the draining bronchus remains patent, the walls of the cavity become free of tubercle bacilli, usually in response to some form of therapy, and the cavity wall undergoes fibrosis with subsequent epithelialization with squamous or columnar epithelium. This leads to a residual saccule opening into a bronchus, a type of saccular bronchiectasis. Case I serves to illustrate open healing.

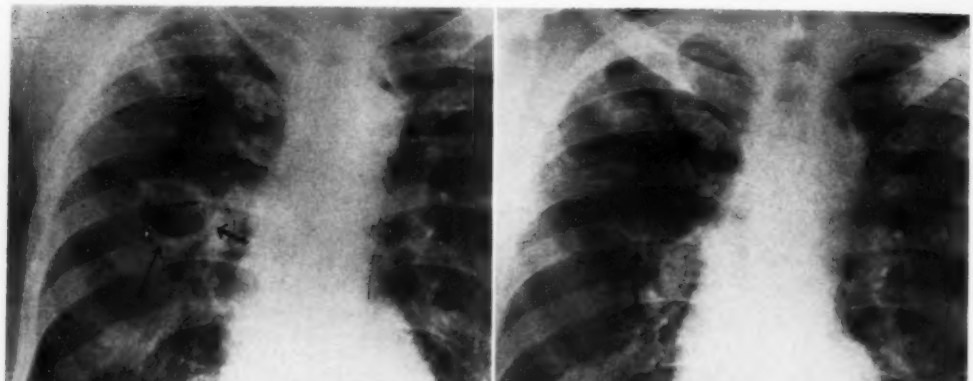

Fig. 1. Case I. A. Cavity in the apex of the right lower lobe. B. Cavity has undergone open healing with decrease in size of lesion, disappearance of pericavitary zone of inflammation, and marked thinning of cavity walls.

CASE I (Fig. 1): W. A., a 55-year-old white male, had a history of tuberculosis dating back to 1936. In 1947 he was classified as having chronic far advanced disease with strongly positive sputum.

X-ray examination on Feb. 10, 1949, revealed a cavity 4 cm. in diameter in the apex of the right lower lobe with disseminated fibronodular infiltrations in the upper lobes. Tubercle bacilli were present in the sputum. The patient was maintained on bed rest and a regimen of streptomycin and PAS, with excellent response. He became afebrile, and tubercle bacilli disappeared from the sputum.

X-ray examination on May 2, 1950, showed considerable shrinkage in the size of the cavity and marked thinning of the walls. The pericavitary infiltration had resolved. Repeated sputum examination and cultures were negative, and comparative roentgenograms remained essentially unchanged in appearance.

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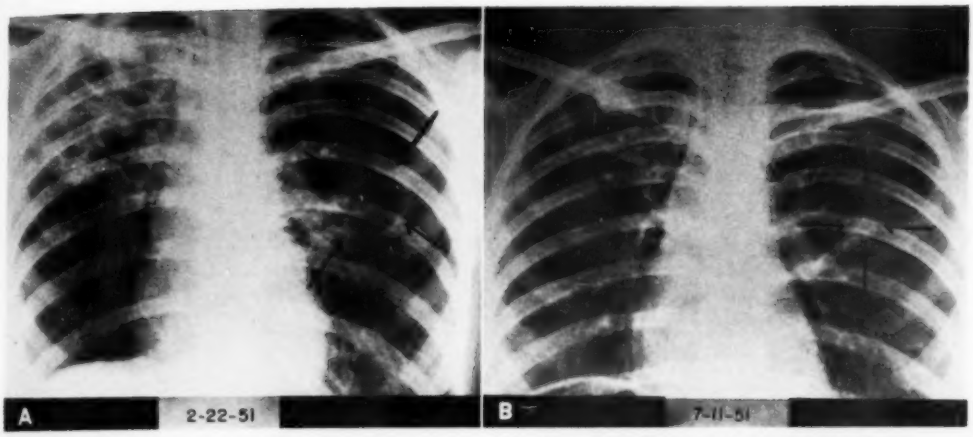


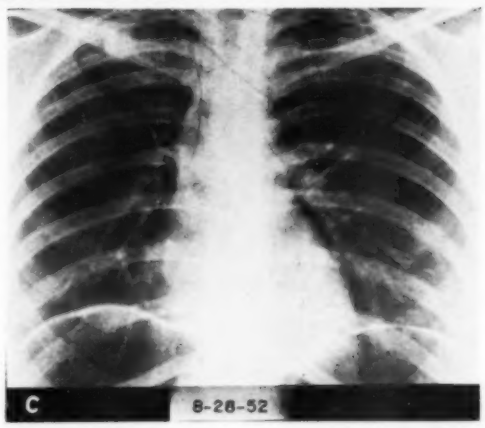


Fig. 2. Case II. A. Far advanced tuberculosis in the right upper lobe and large cavity in apex of left lower lobe. B. Five months later. Marked improvement, with cavity showing atelectatic closed healing. The "tennis-racket" handle extending from the scar of the cavity to the left hilus represents the occluded bronchus and the peribronchial fibrosis consequent to healing. C. Thirteen months later: Further shrinkage and organization have occurred in the lesion, with the drainage bronchus being represented by a fine linear scar.

Recognition of the openly healed cavity is not difficult if one has the advantage of clinical data and serial films. Systemic symptoms subside, the sputum becomes negative, the cavity becomes thin-walled because of regression of the pericavitary inflammatory reaction, and finally the fibrous walls contract. From the roentgen appearance alone, these healed cavities can not be distinguished from active cavities or even from other disease associated with cavitation.

In the closed type of healing, the draining bronchus becomes firmly occluded and the cavity either undergoes atelectasis and scar formation, so called atelectatic closed healing, or the cavity becomes inspissated. In the first type, bronchostenosis occurs, usually as a result of the presence of tuberculous bronchitis. Some form of collapse therapy or, rarely, bed rest will decrease thoracic amplification and favor permanent stenosis and occlusion of the bronchus. The cavity, thus cut off from its free air supply, is rendered anaerobic and, since the human tubercle bacillus is a strict aerobe, becomes sterile (1, 2). The air is absorbed from the lumen and the cavity undergoes atelectasis and eventually fibrosis (3).

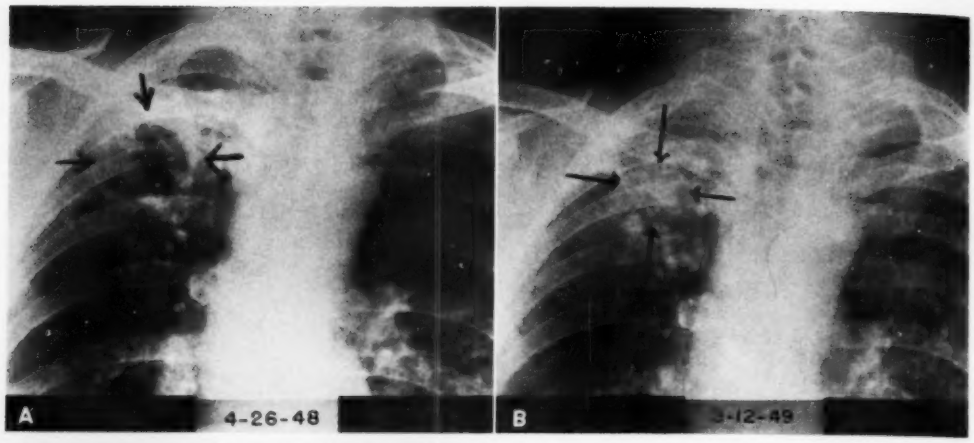
The following case exemplifies closed healing by atelectasis.

CASE II (Fig. 2): D. M., a 23-year-old white housewife, contracted pulmonary tuberculosis in 1950. She was very ill on admission to the sanatorium, with severe systemic symptoms. Her sputum was loaded with tubercle bacilli. X-ray examination on Feb. 22, 1951, disclosed far advanced fibrocaseous and cavernous infiltration in the right upper lobe and in the apices of both lower lobes. A cavity in the apex of the left lower lobe measured 6 cm. in diameter.

The patient was treated with chemotherapy, bed rest, and pneumoperitoneum, and responded almost miraculously.

X-ray examination on July 11, 1951, showed marked resolution of the tuberculosis. The cavity in the left lower lobe had collapsed, with crenation and apposition of its walls.

One year later, Aug. 28, 1952, only a small scar



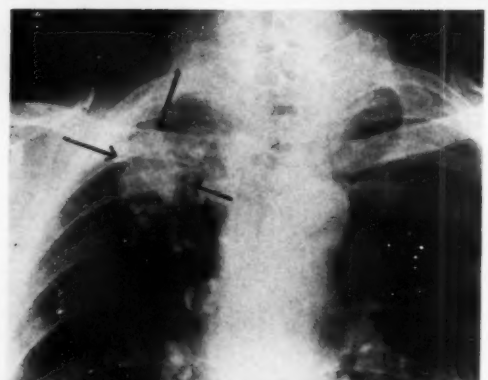


Fig. 3. Case III. A. Large cavity in subapical portion of right upper lobe, indicating breakdown of chronic pulmonary tuberculosis. B. Eleven months later. Cavity is inspissated, its lumen filled with retained caseation and debris, due to firm occlusion of the draining bronchus. Shrinkage of the blocked cavity indicates firm encapsulation. C. Three years and seven months later. Further shrinkage has occurred in the firmly inspissated cavity.

remained in the lung at the site of cavitation. The blocked bronchus remained as a linear scar extending from the cavity scar to the hilus.

It is remarkable what little visible residuum remains in the roentgenogram with atelectatic closure of cavities.

A second type of closed healing takes place when the draining bronchus becomes firmly occluded and the cavity becomes filled with retained caseation and necrotic debris (5, 6). The anaerobic environment is unfavorable for the tubercle bacillus, and the sterile lesion slowly heals with fibrous encapsulation. Such an inspissated cavity remains unchanged in appearance on serial x-ray films except for gradual shrinkage as the fibrous capsule contracts (6). Case III is an example of healing by inspissation.

CASE III (Fig. 3): R. L., a 65-year-old white man, had pulmonary tuberculosis in the right lung dating back many years. In April 1948, he was sent to a sanatorium with systemic symptoms and a positive sputum. X-ray examination on April 26, 1948, revealed old fibronodular and calcific infiltrates in the right upper lobe. A cavity 5 cm. in diameter was present in the subapical portion of the right upper lobe. The patient was put on bed rest. Within a few weeks the cavity filled with excretion, which became organized and consolidated. Simultaneously the symptoms disappeared and the sputum became free of tubercle bacilli.

On March 12, 1949, an x-ray examination revealed the inspissated cavity in the right upper lobe. It had shrunk in diameter to 3.5 cm. On Oct. 16, 1952, it was still visible and measured less than 3 cm. in diameter. The patient remained completely asymptomatic.

Inspissated tuberculous cavities must be differentiated from other nodular densities in the lung, such as the nodular infiltrates of other inflammatory conditions, cysts, benign and malignant tumors. Clinical data almost always suffice for differentiation. An important aid in distinguishing the inspissated cavity is the presence of other associated pulmonary tuberculous infiltrates. The greatest problem in differentiation lies in distinguishing the inspissated cavity from a

large unexcavated caseous focus. Two important criteria help in resolving this problem.

Tuberculous cavities have a "tennis-racket" appearance, with the handle of the racket directed toward the hilus. This appearance is brought about by peribronchial reactive inflammation of the draining bronchus. The inspissated cavity maintains this "tennis racket" appearance; in the caseous parenchymatous focus it is absent. The second and more decisive criterion is obtained by serial interval studies. The progress of blocking can thus be checked, as well as the stability of the encysted inspissated lesion (6). The prognosis of cavity inspissation is favorable. We have followed numerous cases for as long as twenty-one years without seeing these lesions break down (5, 6).

An important entity to be distinguished from the inspissated cavity is the cavity which blocks intermittently. In this type, the draining bronchus is either considerably narrowed or imperfectly occluded, with production of a check-valve mechanism. With inspiratory expansion of the bronchus, air is permitted to enter the cavity, sometimes ballooning it. The intermittently blocked cavity whose bronchus is temporarily or partially occluded is accompanied by the systemic symptoms of sputum retention. Instead of shrinking with the passage of time, these cavities often increase in size. The following case is illustrative of cavity ballooning, but with eventual atelectatic healing.

CASE IV (Fig. 4): G. S., a 43-year-old white housewife, had had pulmonary tuberculosis since she was twenty-five years of age. She broke down in the latter months of 1950 and her sputum became positive. X-ray examination on Feb. 28, 1951, disclosed disseminated fibronodular and calcific infiltration in the left upper lobe and a thick-walled cavity, 4 cm. in diameter, in the subapical area. A segmental resection was advised but refused. Bed rest was instituted, but the sputum remained positive. In December 1951, symptoms of sputum retention developed, with high fever, rapid pulse, and rapid sedimentation rate. The patient was hospitalized, and an x-ray examination on Dec. 11, 1951, disclosed ballooning of the cavity and a fluid level. An exudative infiltration appeared in the lung about the bronchus draining the cavity, and a contralateral exudative spread appeared in the right upper lobe. On Dec. 21, 1951, the cavity was empty. The patient was then given streptomycin with PAS. She improved promptly. Her fever disappeared, and the sputum became negative. Sectional radiographs showed occlusion of the draining bronchus and beginning atelectasis of the cavity. On April 24, 1952, the right upper lobe infiltration was fully resolved. The cavity in the left upper lobe was replaced by a scar, and the peribronchial infiltration had absorbed. Nine months later, Jan. 26, 1953, more fibrosis and consolidation were noted in the area which contained the cavity.

Balloon cavities rarely eventuate in healing. On the contrary, they usually are associated with extension of disease and sometimes cause contralateral spread, especially if the tension within the cavity is high and is then suddenly released. This serves to spatter bacilliferous sputum to other segments of the lungs. In the case cited above, the development of tuberculous bronchitis first produced a check-valve mechanism in the bronchus which ballooned the cavity, stretching its thick walls. The release of intracavitary tension gave rise to spread of the tuberculous infection. However, the drainage bronchus became firmly occluded and the cavity underwent atelectatic collapse. Perhaps this would not have occurred had not the cavity walls become stretched and thinned out consequent to ballooning of the cavity. In any event, the fortunate outcome is unusual with a tension cavity, the development of which worsens the prognosis.

SUMMARY

An understanding of the basic phenomena associated with the healing of tuberculous cavities facilitates roentgen interpretation in pulmonary tuberculosis and promotes more intelligent handling of the individual patient.

Healing occurs by two general methods, open or closed, depending upon whether the draining bronchus remains open or closes.

Open healing is rare while closed healing is common. Closed healing occurs either

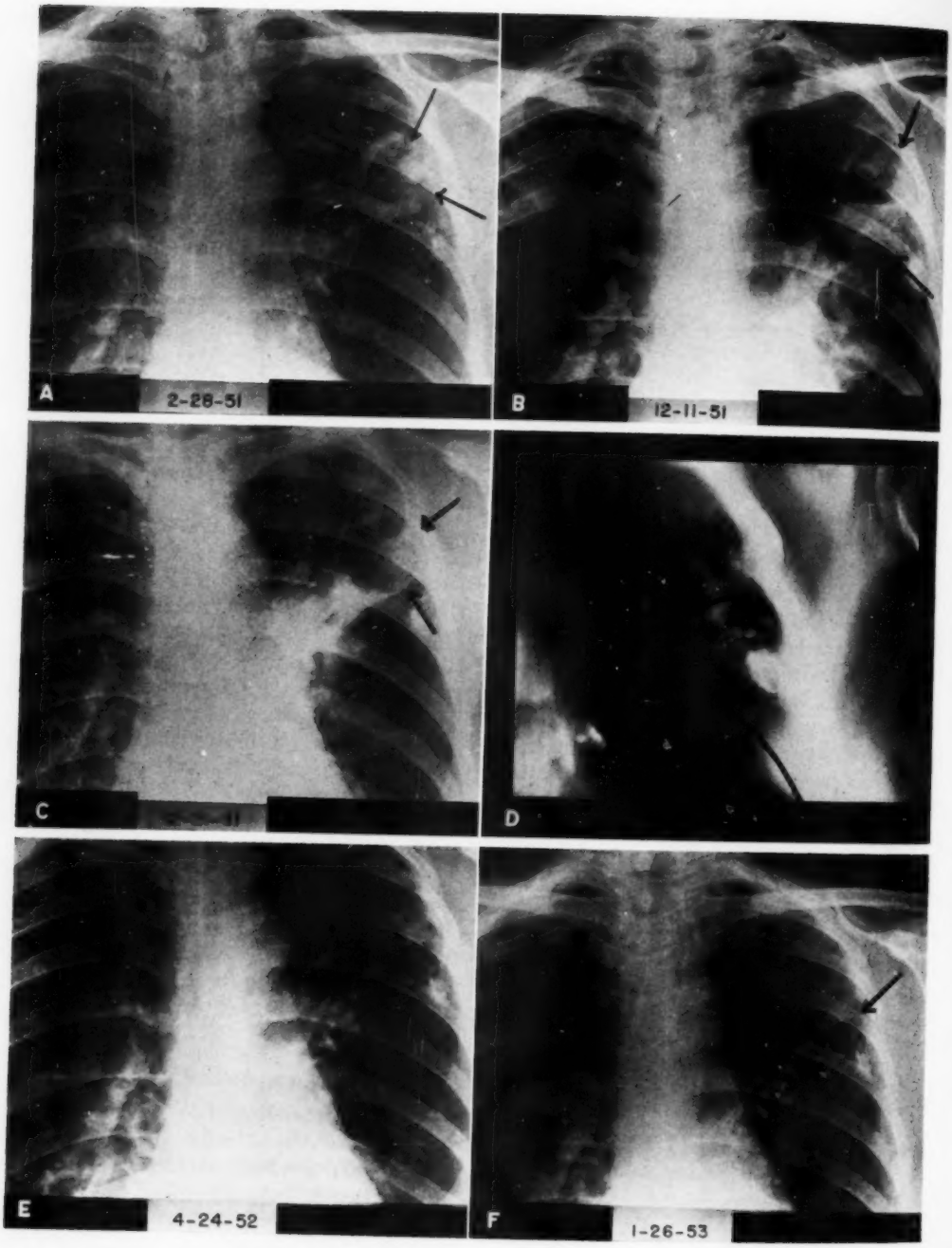


Fig. 4. Case IV. A. Thick-walled cavity in subapical portion of left upper lobe. B. Ten months later. Draining bronchus is partially occluded, causing retention of secretion; ballooning of cavity with thinning of its walls. Intermittent decompression of this tension cavity has caused contralateral spread in the subapical portion of the right upper lobe and in the apex of the left lower lobe. C. Ten days later. The peribronchial zone about the draining bronchus has become dense, suggesting tuberculous lymphangitis in this area with possible closure of the draining bronchus. D. Two months later. Planigraphy shows occlusion of the draining bronchus with infolding of the walls of the cavity as it undergoes atelectatic closed healing. E. Two months later. The cavity is replaced by a scar, as has also taken place with respect to the draining bronchus. F. Nine months later. Further shrinkage of the scar is noted.

by atelectasis and scarring of the cavity or by inspissation.

The clinical importance of each type of healing is discussed.

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SUMARIO

El Mecanismo Cicatrizador de las Cavernas Tuberculosas

La comprensión de los fenómenos básicos enlazados con la cicatrización de las cavernas tuberculosas facilita la interpretación radiológica en la tuberculosis pulmonar y adelanta la asistencia más inteligente del enfermo dado. La cicatrización tiene lugar de dos modos, abierto o cerrado, según que el bronquio de drenaje permanezca abierto o se cierre. La cicatrización a techo abierto es rara.

En la cicatrización abierta, la pared de la caverna experimenta fibrosis seguida de epitelización con epitelio escamoso o cilíndrico. Esto da por resultado un sáculo que desemboca en un bronquio.

En la cicatrización de tipo cerrado, el bronquio de drenaje se ocluye firmemente y la caverna bien experimenta atelectasia y formación de cicatriz, la llamada cicatrización cerrada atelectática, o se espesa. En la primera forma, sobreviene broncostenosis, por lo general a consecuencia de la existencia de bronquitis tuberculosa. En la segunda forma, la caverna se llena de desechos caseosos y esfacelados retenidos. Una lesión de ese género revela poca alteración radiográfica, aparte de reducción gradual a medida que se contrae la cápsula fibrosa.

Hay que diferenciar de la caverna espesada la que se ocluye intermitentemente a consecuencia del estrechamiento del bronquio de drenaje, con producción de un mecanismo de válvula de retención. Estas cavernas rara vez se contraen con el transcurso del tiempo.

Traumatic Epidermoid Cyst of the Terminal Phalanx[1]

T. W. KNICKERBOCKER, M.D., and RALPH REILLY, M.D.

TRAUMATIC epidermoid cyst of the terminal phalanx has been well documented (1, 2), but its existence is not generally realized. The unique features of this lesion are the history of trauma and fluctuation on palpation. This finding helps to differentiate it from chondroma, sarcoma, simple cyst, and giant-cell tumor. The original injury, usually to the terminal phalanx, drives sebaceous epithelium into bone, and months or years later the cyst appears and erodes or expands the phalanx. Removal of the entire cyst is curative.

The accompanying figure shows a typical traumatic epidermoid cyst, subsequently removed. The patient, an eighty-three-year-old man, was a die maker by trade and received numerous finger injuries.

Lesions of similar microscopy are found in the skull, brain, and spinal cord, but these are thought to result from embryonal maldevelopment.

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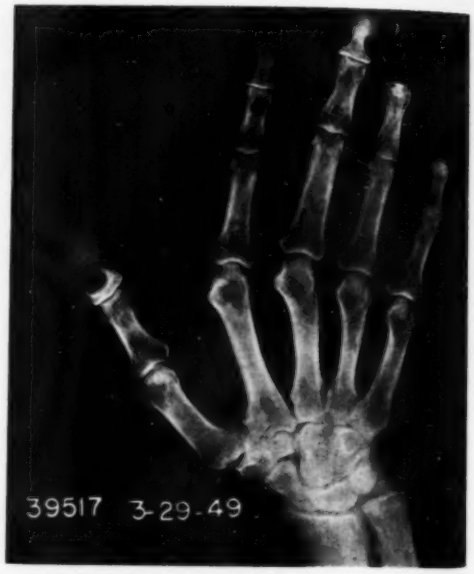

Fig. 1. Expanding cystic lesion in terminal phalanx of left thumb.

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SUMARIO

Quiste Epidermoideo Traumático de la Falange Terminal

Llámase la atención en este trabajo sobre la occurrencia de quiste epidermoideo traumático de una falange. Aunque se ha comunicado esta lesión, rara vez se toma en cuenta su existencia. El enfermo de los AA. era un sujeto de ochenta años, fabricador de troqueles, que se había lesionado los dedos muchas veces.

Comparison of the Tracer Dose and the Therapeutic Dose of I^{131} as to Thyroid Uptake, Effective Half-Life, and Roentgen Dosage[1]

LINDON SEED, M.D., and BERTHA JAFFE, M.D.

SUFFICIENT RADIOACTIVE iodine can be administered to a patient with toxic diffuse goiter to destroy the thyroid gland almost completely. The hyperthyroidism can be converted to hypothyroidism with ease and with certainty, but to convert the hyperthyroid state to a normal, euthyroid state is more difficult. The surgeon in performing a thyroidectomy destroys, under vision, the exact amount of tissue that he deems necessary, but even under this circumstance he produces a genuinely satisfactory result in only 75 to 85 per cent of cases. The outcome of radiotherapeusis is less certain in that it is impossible to visualize the thyroid in order to measure the size of the segment to be destroyed. It is also difficult to deliver a predetermined amount of radiation to the gland; in addition, the destructive effect of the radiation is by no means uniformly predictable.

The most commonly used criteria for determining the dosage of I^{131} are based upon an estimation of the weight of the thyroid gland plus the thyroid uptake of the tracer dose. The dose given is calculated as a predicted number of microcuries (μc) to be accumulated by the gland; 100 μc per gram (μc/gm.) is a generally acceptable dose of this type. The dose may be related only to the weight of the gland, approximately 160 μc being given per estimated gram of weight, or one may simply give 5 or 6 millicuries (mc) to a patient with an ordinary small goiter and add 1 mc for each additional 10 gm. of estimated weight.

Theoretically, the most accurate method of determining dosage is based on a calculation of the amount of destructive ionizing radiation in equivalent roentgens delivered to the thyroid gland. To make this calculation, one would need to know the number of microcuries of I^{131} accumulated by each gram of tissue plus its life expectancy, or effective half-life. The weight of the gland is estimated by palpation; the thyroid uptake is determined by the tracer dose, and its half-life is calculated from successive examinations. The data are placed in a formula, and a predicted number of equivalent roentgens physical (rep) are delivered to the patient's thyroid gland by administering an appropriate number of millicuries of I^{131}. Undoubtedly this is the most logical and most scientific way of attacking the problem of dosage, but it is far from perfect.

There are several possibilities of error. First, of course, is the natural error in estimating the size of the gland. Next is the error in assuming that the I^{131} accumulated by the thyroid is distributed in a uniform manner. Actually the distribution is notoriously spotty, and as a result the ionizing radiation is also spotty. Then there is the obvious error in assuming that all diffusely hyperplastic glands are equally sensitive to internal radiation. In addition to these unavoidable assumptions, there arises still another possibility of error, namely, in assuming that the treatment dose behaves exactly as does the tracer dose. In order to analyze the problem, we have made a comparison of the thyroid uptake and the effective half-life (EHL) of the tracer dose and the therapeutic dose in 91 patients with hyperthyroidism. We have also attempted to correlate the clinical effect as related to dosage. This investigation is similar to that carried out by Freedberg and his colleagues (2–6). It was their excellent work

[1] From the Augustana Hospital Isotope Laboratory, Chicago, Ill., the Nelson M. Percy Research Foundation, and the Oak Park Hospital Isotope Laboratory, Oak Park, Ill. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec 13–18, 1953.

and the logic of their position that induced us to make this survey.

METHODS

A tracer dose of 40 μc of I^{131} was administered to each patient. A twenty-four-hour thyroid uptake was determined by using a bismuth cathode counter at a far distance. The thyroid gland was checked for radioactivity at three-day intervals. In most instances a total of only three determinations were made over a period of one week; in some cases there were more, but never less. The EHL was calculated from these data.

The measurement of several millicuries of I^{131} in the thyroid gland is not as simple a process as measuring a tracer dose and is subject to more error. In order to reduce the counting rate when measuring such large quantities of radioactivity, we placed lead absorbers (6.8 to 2.4 mm. thick) in front of a bismuth cathode counter and made the measurements at a distance of 70 cm. from the center of radiation in the neck. A shield of lead 2.5 cm. thick was then placed over the neck in order to screen out radiation from the thyroid gland and a second count was made. The bismuth cathode counter with a thick absorber was calibrated in the same manner. The therapeutic dose was placed at a distance of 70 cm. and a count taken. When the 2.5-cm. lead shield was placed in front of the source, it was found that approximately 4 per cent of the original measured radiation would be recorded.

I^{131} has two principal gamma radiations, one of 0.303 mev, with an 85 per cent abundance, and one of 0.638 mev, of 12 per cent abundance. One-half of the former is screened out by 2 mm. of lead and one-half of the latter by 5 mm. of lead. A 2.5-cm. lead shield will not transmit 4 per cent of primary I^{131} gamma rays. But in placing heavy absorbers over the Geiger tube we eliminated most of the weaker rays. As a result, in this particular set-up the interposition of the shield eliminated only 95 to 97 per cent of the counts, depending on the number of absorbers. The calculations were made as shown in the accompanying sample.

1.	Counts/min. at 70 cm. from the neck.	8,511
2.	Minus the counts/min. after interposition of lead shield (which equals 4 per cent of thyroid radiation plus body radiation).....	426
3.	96 per cent of thyroid radiation.....	8,085
4.	100 per cent of thyroid radiation = $\frac{8,085}{0.96}$.....	8,422
	1,400 counts/min.....	1 mc
	8,422 counts/min.....	7.01 mc

Line 1, the counts per minute at 70 cm., represents the thyroid radiation plus the primary radiation from the I^{131} circulating throughout the body, designated as the body radiation. Practically all scattered radiation is eliminated by the heavy absorber in front of the Geiger tube. Line 2, the counts per minute after interposition of a 2.5-cm. lead shield over the thyroid gland, represents 4 per cent of the thyroid radiation which comes through the shield plus the body radiation. Line 2 subtracted from Line 1 equals 96 per cent of the thyroid radiation, and this value divided by 0.96 gives the thyroid radiation. By previous assay, it was determined that under similar circumstances 1 mc of I^{131} gave 1,400 counts per minute. Making use of this figure, the counts are converted to millicuries.

The Geiger tube was calibrated with absorbers of varying thickness against a known number of millicuries of I^{131}. Every shipment of radioactive iodine was assayed, but not every therapeutic dose was assayed individually. The appropriate number of milliliters of the solution was measured out and given to the patient. In retrospect, we believe that this is a mistake. An accurate comparison requires a measurement of the radioactivity of each dose in a manner identical with the measurement of the radioactivity in the neck. This was done, however, only periodically, in order to check our technic. Although the method is basically sound, errors creep in rather easily. A small error of about 3 to 6 per cent occurs if one does not take

into consideration the absorption of the radiation from the thyroid gland due to the intervening soft tissues. If the dose is measured in a 25-ml. flask in air, this correction is needed; if the measurement is made in a 25-ml. flask placed just within a 1-liter beaker filled with water, it will not be necessary. We acquired a uniform error in an unexpected manner. The therapeutic dose was assayed periodically by withdrawing the liquid from the vial in which it was contained by means of a tuberculin syringe. But our therapeutic doses were actually obtained by means of a 5-ml. pipette with a needle attached to its end. The 5-ml. pipette would uniformly deliver a slightly smaller quantity of the measured liquid; as a result, the calculated figures on the thyroid uptake of the therapeutic dose as reported previously were too low.

The thyroid radioactivity was measured initially on the day following the therapeutic dose, again in three to seven days, and then every week for three weeks. The EHL was calculated from these data. It might be more accurate to make frequent measurements during the first week and use these primarily in calculating the EHL of the therapeutic dose in view of the fact that most of the radioactivity will be expended during the first week. We found, however, that the diminution of the radioactivity in the thyroid took place at a fairly uniform exponential rate, and that we were more certain of the accuracy in our measurements taken several days after the dose had been administered, at which time there was little I^{131} circulating throughout the body. More frequent *in vivo* measurements of both the tracer dose and the therapeutic dose would be advisable but would not be feasible as a routine clinical procedure.

The calculation of the roentgens equivalent physical (rep) was carried out according to the formula of Marinelli, Quimby and Hine (8).

$$\text{rep} = 160 \times \frac{\text{dose in } \mu c}{\text{wt. of thyroid}} \times \frac{\text{EHL}}{8}$$

This formula is based on the assumption that 1 μc of I^{131} distributed evenly throughout 1 gm. of tissue and held there during its entire physical life will deliver 160 rep. Recently, previous estimations of the average beta energy of I^{131} have been reduced, and some workers now consider that 1 μc of I^{131} per gram of tissue will deliver only 135 rep (7). We have preferred to use the original estimate in order to keep our final figures comparable to those of previous reports. Furthermore, the International Congress of Radiology has recommended that the rep be replaced by the unit "rad," 100 ergs/gm., and this unit will probably be used in future calculations. We have assumed that the total thyroid uptake took place immediately. No effort was made to correct for the lag from the moment of drinking the therapeutic dose until the moment maximum thyroid accumulation had taken place.

The data are listed in Table I in three groups: 67 patients with toxic diffuse goiter; 18 patients with postoperative, recurrent toxic diffuse goiter; 6 patients with toxic nodular goiter. The analysis is limited to the first therapeutic dose. The end-result of therapy was determined largely by talking to each patient's physician on the telephone and asking him to classify the result in one of four categories, namely, satisfactory (sat.), improved (impr.), no improvement (none), or hypothyroid (hypo.). Some of the patients who had an unsatisfactory result later had a second or third treatment. Any patient taking desiccated thyroid was considered to have hypothyroidism. The follow-up period is listed in months. The patients in each group are arranged in descending order of magnitude of rep delivered to the thyroid gland.

Because of relatively unsatisfactory results in the treatment of a few patients with large toxic diffuse goiters, an experience comparable to that which McCullagh has reported in detail, we recommend that large goiters be removed; therefore, very few patients with large glands are to be found in this group. Many patients had no palpable thyroid enlargement; in these

TABLE I: COMPARISON OF TRACER DOSE AND THERAPEUTIC DOSE IN TOXIC DIFFUSE GOITER, POSTOPERATIVE RECURRENT TOXIC DIFFUSE GOITER, AND TOXIC NODULAR GOITER

	Tracer Dose					Therapeutic Dose						
				Predicted								
No.	Wt. of Gland (gm.)	Thyroid Uptake (per cent)	E.H.L.	Thyroid Accumulation (μc/gm.)	Rep	Dose (mc.)	Thyroid Uptake (per cent)	E.H.L.	Thyroid Accumulation (μc/gm.)	Rep	Result	Follow-up (months)
						Toxic Diffuse Goiter						
1.	65	65	8.2	250	41,500	25	64	8.4	246	41,300	Sat.	15
2.	30	56	6.7	187	25,100	10	65	7.1	216	30,800	Sat.	18
3.	35	64	3.2	274	17,500	15	63	5.2	270	28,100	Sat.	18
4.	35	60	5.8	120	14,000	7	66	7.2	132	19,200	Sat.	16
5.	35	56	6.0	160	19,200	10	75	4.5	214	19,200	Sat.	19
6.	45	82	5.0	145	14,400	8	92	5.5	163	18,000	Hypo.	6
7.	35	67	5.5	153	16,900	8	86	4.2	196	16,600	Sat.	13
8.	45	73	4.3	136	11,700	8.4	76	5.7	142	16,300	Hypo.	10
9.	45	81	3.0	180	11,000	10	75	4.7	167	15,700	Sat.	14
10.	45	72	5.5	160	16,100	10	67	5.2	148	15,600	Sat.	7
11.	35	75	6.0	107	12,800	5	72	5.6	138	15,500	Sat.	19
12.	40	80	4.9	140	13,700	7	78	5.7	136	15,400	Hypo.	13
13.	45	74	5.2	164	17,000	10	74	4.6	164	15,200	Sat.	16
14.	30	73	5.7	146	16,600	6	71	5.2	142	15,000	Sat.	19
15.	30	62	7.2	103	15,000	5	54	8.2	90	14,800	Sat.	18
16.	40	70	6.4	128	16,400	7.3	62	6.5	113	14,600	Hypo.	10
17.	30	81	5.2	113	11,900	7	66	7.8	92	14,400	Sat.	12
18.	45	69	7.1	123	17,500	8	92	4.3	163	14,000	Sat.	8
19.	35	34	5.4	97	10,500	10	67	3.7	191	14,000	Hypo.	18
20.	45	72	4.6	128	11,900	8	81	4.8	144	13,800	None	12
21.	60	65	6.8	130	17,700	12	62	5.4	125	13,600	Sat.	17
22.	60	64	5.6	96	10,700	9	71	6.2	106	13,200	Sat.	18
23.	40	43	4.2	86	7,300	8	70	4.7	140	13,200	Sat.	14
24.	45	40	6.1	109	13,300	10	54	5.4	120	13,100	Hypo.	10
25.	35	77	4.8	132	12,700	6	73	5.2	125	13,000	Sat.	8
26.	55	75	5.2	109	11,500	8	90	4.8	131	12,600	Sat.	7
27.	40	83	3.6	125	9,000	6	75	5.5	113	12,500	Sat.	18
28.	45	82	4.7	110	10,400	6	78	5.9	104	12,300	Sat.	18
29.	35	42	4.5	84	7,500	7	40	7.6	80	12,200	Sat.	14
30.	40	72	4.7	127	12,200	7	60	5.7	105	12,100	Sat.	16
31.	30	81	4.9	162	15,800	6	63	4.8	126	12,000	Sat.	7
32.	40	85	5.0	149	15,000	7	67	5.0	117	11,800	Sat.	18
33.	35	66	6.0	132	15,800	7	51	5.7	102	11,600	Impr.	11
34.	45	72	5.2	112	11,800	7	77	4.7	120	11,300	Hypo.	13
35.	50	67	7.3	80	11,700	6	62	7.2	74	10,800	None	6
36.	35	81	6.3	139	17,600	6	66	4.8	113	10,800	Hypo.	7
37.	40	43	7.0	65	9,200	6	51	7.1	76	10,800	Sat.	12
38.	45	71	4.7	110	10,400	7	63	5.5	98	10,800	Hypo.	14
39.	35	55	3.3	94	6,200	6	66	4.8	113	10,800	Impr.	8
40.	45	65	5.7	101	11,600	7	80	4.3	124	10,700	Sat.	14
41.	40	67	4.7	101	9,200	6	82	4.2	123	10,400	Sat.	11
42.	75	73	5.5	88	9,700	9	85	5.0	102	10,300	Sat.	2
43.	30	48	7.5	96	14,400	6	45	5.7	90	10,200	Hypo.	6
44.	35	66	3.3	113	7,400	6	76	3.9	76	10,200	Sat.	2
45.	40	63	6.9	110	15,100	7	50	5.8	87	10,200	Sat.	17

we estimated the weight of the gland at 30 gm. It will be noted that in the patients with recurrent toxic goiter the weight is frequently given as 25? gm. This is a purely fictitious figure; it merely represents what we think might be a general average for a group of patients who have been operated on and who have no palpable goiter in the neck.

COMPARISON OF THYROID UPTAKE OF TRACER AND THERAPEUTIC DOSES

In Figure 1 the thyroid uptake of the tracer dose is compared with that of the

TABLE I (*Continued*)

	Tracer Dose					Therapeutic Dose						
				Predicted								
No.	Wt. of Gland (gm.)	Thyroid Uptake (per cent)	E.H.L.	Thyroid Accumulation (μc/gm.)	Rep	Dose (mc.)	Thyroid Uptake (per cent)	E.H.L.	Thyroid Accumulation (μc/gm.)	Rep	Result	Follow-up (months)
46.	30	71	5.1	166	17,000	7	62	3.5	145	10,200	None	18
47.	35	64	5.1	146	15,000	8	46	4.7	105	9,900	Hypo.	9
48.	55	67	6.2	97	12,100	8	71	4.8	103	9,900	Sat.	11
49.	40	64	5.2	128	13,500	8	57	4.7	114	9,800	Sat.	3
50.	60	67	5.3	89	9,400	8	85	4.1	113	9,200	Sat.	11
51.	40	78	7.0	98	13,800	5	64	5.6	80	9,000	Sat.	8
52.	55	65	4.8	83	8,000	7	80	4.2	102	8,600	Hypo.	3
53.	60	61	6.5	102	13,200	10	58	4.4	97	8,500	None	6
54.	75	73	6.0	78	9,400	8	75	5.2	80	8,300	Impr.	14
55.	35	61	4.1	122	10,000	7	49	4.1	98	8,000	Sat.	11
56.	65	64	5.0	79	8,000	8	51	6.0	63	7,600	Impr.	6
57.	45	63	7.1	63	14,000	7	77	3.0	120	7,300	Sat.	18
58.	45	66	4.1	103	8,400	7	57	3.9	89	7,000	Impr.	3
59.	45	45	6.7	60	8,100	6	54	4.8	72	6,900	Sat.	3
60.	35	84	5.7	96	11,000	4	64	4.7	73	6,900	Sat.	6
61.	40	48	7.1	60	8,500	5	54	4.9	69	6,700	Hypo.	13
62.	45	78	3.7	104	7,700	6	63	3.8	84	6,500	None	4
63.	60	80	6.3	80	10,100	6	62	5.2	62	6,500	Impr.	10
64.	120	43	2.4	72	3,500	20	47	3.6	78	5,600	None	4
65.	55	61	8.0	67	10,700	6	52	4.8	57	5,500	Sat.	11
66.	75	65	5.2	43	4,500	5	62	4.2	41	3,500	Sat.	7
67.	45	45	3.9	85	6,700	8	33	2.3	65	2,900	Sat.	14
					Postoperative Recurrent Toxic Diffuse Goiter							
1.	25?	68	6.5	270	35,300	10	75	7.0	300	42,000	Sat.	15
2.	25?	55	5.3	262	27,700	12	68	4.5	326	29,200	Sat.	18
3.	25?	66	5.1	265	26,700	10	64	5.0	256	26,000	Hypo.	20
4.	25?	61	4.0	242	19,400	10	69	4.2	277	23,500	Hypo.	17
5.	25?	35	6.7	111	15,000	8	35	7.7	112	17,200	Sat.	13
6.	25?	56	5.5	157	17,300	7	56	5.2	157	16,600	Hypo.	12
7.	30	65	5.6	130	14,700	6	52	6.9	104	14,300	Impr.	6
8.	30	44	9.0	102	18,400	7	41	7.4	96	14,200	Sat.	12
9.	40	78	6.2	118	14,600	6	46	7.2	69	9,900	Sat.	4
10.	40	69	4.2	138	11,700	8	56	4.3	112	9,700	Sat.	8
11.	25?	41	3.8	116	8,900	7	30	5.2	84	8,700	Sat.	14
12.	50	71	5.6	85	9,500	6	70	4.5	84	7,500	Sat.	12
13.	25?	21	8.0	59	9,400	7	16	8.2	45	7,400	Sat.	20
14.	25?	33	4.0	92	7,400	7	29	3.8	81	6,200	Hypo.	5
15.	50	65	5.9	65	7,600	5	56	4.2	56	4,700	Sat.	17
16.	25?	43	4.3	86	7,400	5	37	3.0	74	4,500	Sat.	3
17.	25?	42	4.3	85	7,300	5	36	2.7	72	3,900	Hypo.	3
18.	30	21	3.5	43	3,000	6	22	2.5	44	2,200	Sat.	12
					Toxic Nodular Goiter							
1.	80	71	8.0	178	28,400	20	82	7.7	205	31,500	Sat.	16
2.	90	59	7.4	164	24,300	25	61	5.1	170	17,400	Impr.	5
3.	125	18	8.7	36	6,300	25	29	9.0	58	10,500	None	3
4.	180	50	7.3	70	10,200	25	48	7.2	67	9,600	Impr.	14
5.	60	56	7.7	93	14,300	10	47	5.7	78	8,900	Sat.	11
6.	150	32	8.8	43	7,600	20	47	6.4	63	8,100	Impr.	11

therapeutic dose for the patients with true exophthalmic or toxic diffuse goiter. There is very little variation Previously we reported a general reduction in the uptake of the therapeutic dose (11). This was due, as explained above, to an error in measuring the dose. The mean uptake of the tracer dose was 65.5 and of the therapeutic dose 64.4 per cent, a little lower than our general average of 70 per cent.

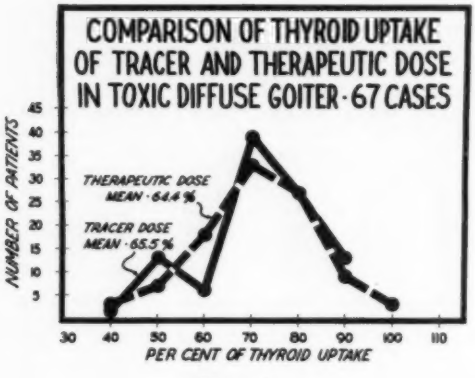

Figure 1

In Figure 2 are charted the per cent deviations of the uptake of the therapeutic dose from that of the tracer dose for all 91 patients. Forty-nine patients (54 per cent) were within ±15 per cent of the predicted uptake. There are some extreme variations, but by and large the uptake of the therapeutic dose follows that of the tracer dose with reasonable predictability.

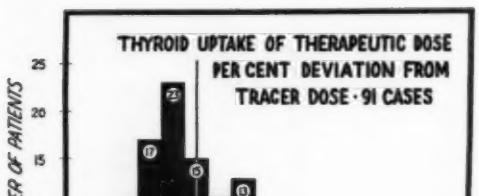

Figure 2

COMPARISON OF EHL

In Figure 3 are charted the EHL of the tracer and therapeutic doses in the patients with true toxic diffuse goiter. The uptake of the therapeutic dose is slightly lower than predicted, the mean of the tracer doses being 5.4 days and that of the therapeutic dose 5.2 days.

Figure 4 gives the percentage deviation of the EHL of the therapeutic dose for all 91 patients. For 40 patients, or 44 per cent, the EHL varied beyond ±15 per cent. There are many more patients showing an EHL less than predicted than showing a greater.

COMPARISON OF REP

Figure 5 shows the per cent deviation of the delivered dose, in rep, from the predicted dose. The variations are rather large, extending from 36 per cent to over 175 per cent of the predicted dose. For only 58 patients (64 per cent) did the delivered dose lie within ±25 per cent of the predicted dose (rep). On the whole, the dose in roentgens was less than predicted, and the variation a little large for even clinical accuracy.

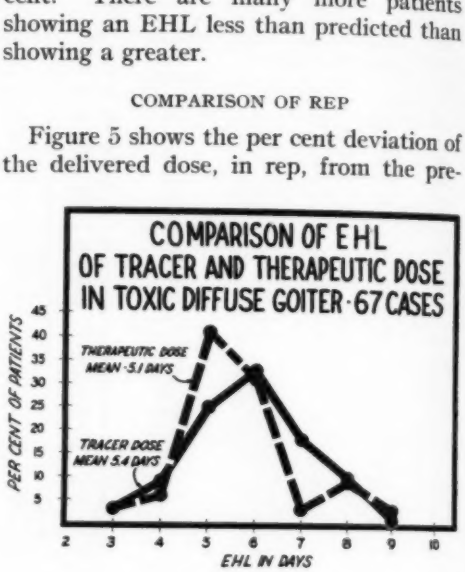

Figure 3

TABLE II: RESULT IN PATIENTS WITH TOXIC DIFFUSE GOITER FOLLOWING A SINGLE THERAPEUTIC DOSE OF I^{131}

Dose in Rep	Satisfactory	Became Hypothyroid	Improved	Not Improved
41,300–15,000	10	3	0	0
15,000–10,000	21	8	2	3
10,000– 5,000	9	3	4	3
5,000–	2	0	0	0
	42	14	6	6

CLINICAL RESULT

Table II is a résumé of the clinical results in toxic diffuse goiter as related to a single dose expressed in rep. The amount

of radiation as measured in rep may vary by a factor of 4 with very little effect on the end-result. A dose as low as 2,900 rep produced a satisfactory result, while a dose as high as 10,000 rep had no noticeable effect. Hypothyroidism followed a dose of 6,700 rep, while the maximum dose administered, 41,300 rep, produced only a euthyroid state. Some of the discrepancies are

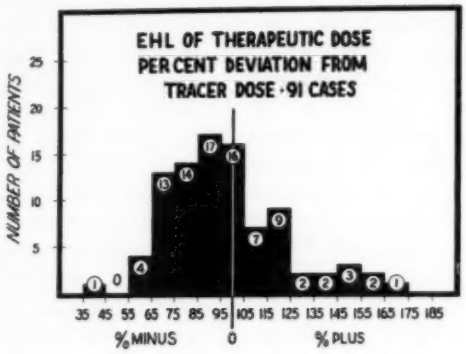

Figure 4

undoubtedly due to correctable errors in technic; some are due to the variability in the radiosensitivity of a hyperplastic thyroid gland. Regardless of the cause, in our hands the calculated dose, in rep, actually delivered to the thyroid gland had such a variable clinical result that, on this basis, the labor involved in the calculation of a predicted dose in rep seems hardly worth while. And yet, the investigation, being of a comparative nature, requiring careful measurements, proved to be of considerable value in checking our technic of radiation measurement. We would recommend it for this reason alone. The 67 patients constitute only a portion of all patients treated and were chosen because they had frank hyperthyroidism and lived close enough to the laboratory to permit frequent visits. None were hospital patients. Of the 14 patients (20 per cent) who became hypothyroid, half or more will ordinarily readjust to a euthyroid state with the passage of time. Of the 18 per cent who were not cured, about half will return for a second treatment.

Table III is a résumé of the results as re-

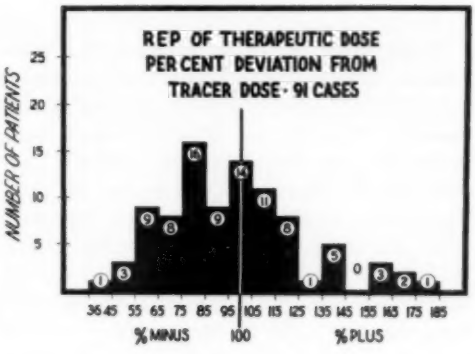

Figure 5

TABLE III: RESULTS FOLLOWING A SINGLE THERAPEUTIC DOSE IN REPORTS COLLECTED FROM THE LITERATURE*

Rep	Number of Patients	Per Cent Who Became Euthyroid	Per Cent Who Became Hypothyroid	Per Cent Who Remained Hyperthyroid
2,000– 5,000	43	51	5	44
5,000– 7,000	53	58	0	42
7,000–10,000	56	59	20	21
10,000+	32	53	12	34

* Collected groups of cases showing result of single dose: Werner *et al.* (12), 87 patients; Miller and Sheline (10), 38 patients; Freedberg *et al.* (6), 39 patients; Blomfield *et al.* (1), 20 patients.

lated to dosage, in rep, collected from the literature. The various authors did not report their results in a uniform manner, but the tabulation is a reasonably accurate analysis. The correlation between dosage and result is none too satisfactory. It will be noted that the initial dose administered in this group is smaller than we give, but the percentage of patients remaining hyperthyroid is considerably larger.

The patients with recurrent toxic diffuse goiter were placed in a separate category because in this group it is almost impossible to make an accurate estimate of the weight of the thyroid gland and because the thyroid uptake is at a generally lower level. In the group of toxic nodular goiters not only is the thyroid uptake relatively low but the glands are relatively large; so, in spite of doses of 20 to 25 mc, only 2 patients out of 6 obtained a satisfactory result after the first treatment dose.

DISCUSSION

There have been four reports on a comparative study of the tracer and the therapeutic dose[2]: one by Freedberg and his coworkers (6), one by Blomfield and associates (1), one by Miller and Sheline (10), and one by Werner, Quimby, *et al.* (12). The most complete analysis, and undoubtedly the most accurate, is by Freedberg. He found that the predictability of the delivered thyroid radiation of a therapeutic dose, on the basis of the uptake and biologic half-life of a tracer dose, is sufficiently accurate to allow for calculated I^{131} dosage. Although our findings do not show as close a correlation as do his, and in spite of a previous report to the contrary, we believe that he is basically correct. There is a considerable degree of inaccuracy inherent in our method of measurement in that the tracer dose was assayed individually and the assayed quantity compared on a percentage basis with the twenty-four-hour thyroid content, while the therapeutic dose was not assayed individually and the uptake was determined quantitatively by a different technic than that of the tracer dose. This is not a proper way in which to make a comparative study. Freedberg's "method for measurement of thyroid uptake and turnover by external counting consisted of four Geiger-Müller tubes connected in a parallel electrical circuit and arranged in a circle of 45 cm. radius in a horizontal plane about the neck. This method provides quantitative measurement of I^{131} thyroid gland content, virtually independent of the size and location of the thyroid gland." Furthermore, he checked the thyroid accumulation of both tracer and therapeutic dose in the identical set-up, merely correcting the high counts of the therapeutic uptake for dead time. We believe that his method is more accurate than the use of a single Geiger tube such as we employed, which is commonly used in most laboratories. Whether the added time and labor involved in calculating the dosage in roentgens is profitable is still a questionable matter. Blomfield and associates think it is; Miller and Sheline think it is not. As shown in Figure 5, the actual dose delivered, in roentgens, does correspond generally to the predicted dose, but there is a wide variation. The most discouraging aspect, however, is shown in Table II, in our attempt to correlate the dose, in roentgens, with the end-result. Freedberg also found a rather erratic relationship; of 26 patients receiving only one therapeutic dose, 20 became euthyroid after an estimated thyroid radiation of 5,900 to 17,000 rep. The discrepancy has a twofold explanation. First, there can be large errors in estimating the weight of the gland; these are inevitable, but in a group of patients with uniformly small thyroid glands, such as we are reporting, this should not alter the calculations by more than 50 per cent. Secondly, a hyperplastic thyroid is definitely more sensitive to internal radiation than is a normal thyroid, and it is reasonable to suppose that this sensitivity varies among diffusely hyperplastic goiters. The median dose for optimum results is in the neighborhood of 10,000 rep. The median optimal dose calculated in terms of the uptake of the gland is in the neighborhood of 100 μc per gram. The clinical result when this method of estimating the dose is used has statistically the same accuracy as that when the dose is estimated in rep. The same end-result could be accomplished by administering 5 or 6 mc to a patient with a small diffuse goiter (35 gm.) and adding 1.0 to 1.5 mc for each additional 10 gm. of estimated weight. It will be noted that all these doses carry a fairly high incidence of hypothyroidism and should be reduced if hypothyroidism is an unwanted complication.

[2] A later analysis was published by Schmidt, C. E., and Nadelhaft, J.: Effective Half Life of Radioactive Iodine (I^{131}) in Hyperthyroid Gland: Its Significance in Treatment of Thyrotoxicosis. Lab. Invest. **2:** 135–139, March-April 1953. These authors conclude that the rate at which the destructive irradiation is exerted, and not the total radiation dosage, is the determining factor in the clinical result. A total dosage delivered in four and a half days or less was more destructive than the same dose delivered over a period of seven days or more.

SUMMARY

1. A comparison was made with respect to the uptake and effective half-life of the tracer dose and the first therapeutic dose of I^{131} in 91 patients with hyperthyroidism. The thyroid uptake and the effective half-life of the therapeutic dose can be predicted with reasonable accuracy.

2. An analysis was made of the clinical result as related to the dosage, in equivalent roentgens, in 67 patients with toxic diffuse goiter. The correlation of dosage and result seemed no better than that obtained by simply calculating the dosage on the basis of the thyroid uptake of the tracer dose and the estimated weight of the gland.

3. We doubt whether the effort to calculate dosage on the basis of the actual amount of radiation to be delivered to the gland improves the clinical results. Nevertheless, we believe that it is an advisable exercise, if for no other reason than that it compels a careful technic in radiation measurement and is really the only logical way of attacking the problem.

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SUMARIO

Comparación de la Dosis Despistadora y la Dosis Terapéutica de I^{131} en Cuanto a Absorción de Tiroides, Semi-Vida Eficaz y Dosificación Roentgenológica

Hizose una comparación de la dosis despistadora y la primera dosis terapéutica de I^{131} en enfermos que padecían de hipertiroidismo en relación con la absorción de tiroides y la semi-vida eficaz. Tratóse además de correlacionar el efecto clínico con la dosis calculada en término de roentgens equivalentes (rep) entregados a la glándula. Los casos estudiados comprendieron 67 de bocio difuso tóxico, 18 de bocio difuso tóxico recurrente postoperatorio y 6 de bocio nodular tóxico.

Observóse que cabe predecir con bastante exactitud la absorción de tiroides y la semi-vida eficaz de la dosis terapéutica. La dosis en rep entregada discrepó algo ampliamente de las predicciones, y la correlación de la dosis y del resultado clínico no pareció mejor que la obtenida con el mero cálculo de la dosis a base de la absorción de tiroides de la dosis exploradora y del peso calculado de la glándula.

Por consiguiente, aunque parezca dudoso que el esfuerzo dedicado a calcular

la dosis a base de la cantidad exacta de radiación por entregarse a la glándula mejore los resultados clínicos, constituye, sin embargo, un ejercicio conveniente, aunque no sea más que porque impone una técnica cuidadosa en la medición de la irradiación y representa la senda lógica para atacar el problema.

DISCUSSION

Carleton B. Peirce, M.D. (Montreal, Canada): Until all of us know more of the normal and the pathologic physiology of the thyroid gland than we do at present and have pursued meticulous technics in the measurement of the use of iodine (by means of I^{131} in tracer amounts or therapeutically), variations in uptake, biologic half-life and therapeutic effect of the radioactive isotope will continue to disturb deductions and predictions thereto.

The essayists have pointed out some of the problems and have commented upon certain known sources of error in their observations. They express some doubts as to the value of attempts to calculate radiation dosage, in view of the recurring differences between their predicted or calculated dose and the measured dose in the individual patient. I consider continuation of such studies important.

The history of radiation therapy has been marked by conflict between empirical treatment and studied consideration of the biologic factors involved, with frequent disappointment or consternation over the biologic result produced. Such will be as common with internal specific irradiation as heretofore with external x- and gamma radiation unless we pay more attention to the biologic effect. This paper indirectly emphasizes the need for better appreciation of the biologic factors.

The purpose of a tracer study in a given patient is to assess the requirement of the thyroid for iodine, its use of this essential chemical in the synthesis of its hormones, the discharge of those hormones in response to the normal or abnormal physiologic demand of the individual, and the proportionate discard of the iodine by urinary excretion, or its re-use by the thyroid. If carefully done, such a tracer study will afford considerable—and quite accurate—information as to that patient's thyroid metabolism.

But the conditions under which each patient is examined must be carefully controlled, and for any valid comparison all must be equally governed. We know a great deal about the overall iodine requirement and the alteration of the tracer pattern consequent to the intake of stable iodine by diet, medication, or the absorption from some foreign substance such as the iodinated contrast media, as well as concerning the effective block of re-use of iodine induced by the anti-thyroid drugs. Such sources of error or variation must be eliminated if possible. The wide discrepancy in some of the essayists' cases suggests such factors as the cause.

Further, Wyant's observations suggest that even the small amounts of radiation derived from tracer quantities can alter the function of some thyroid cells. Leblond and others have shown the rapid rate of uptake and early synthesis of the iodine into the organic forms. We do not know yet how rapidly changes in sensitivity of the thyroid cells may occur. Nor are we fully aware of the physiologic factors which may affect the threshold for discard. Consequently, if we are to compare biologic half-life of tracer and of therapeutic doses, exactly comparable conditions must be maintained.

In our Department, we have not found, nor do Freedberg's observations indicate, a significant difference between the biologic half-life of the tracer dose and the therapeutic dose under suitably controlled conditions.

In the determination of the magnitude of the therapeutic dose required, by means of the proposed formula, an accurate half-life factor will not be able to offset inaccuracy in the estimation of thyroid mass nor inequality of metabolic activity in various portions of the gland. So far, no one has brought forward a simple method for accurate measurement of the thyroid. Careful scanning with a directional counter will afford a good opportunity to assess the length, breadth and depth as well as the metabolic uniformity of the tissue. In addition, a radial arrangement, or a bilateral alignment of mass counters for the neck and thigh, with observations at suitable intervals during the first thirty to thirty-six hours of the tracer study, and subsequently over eight to ten days, to determine the biologic half-life, is considered preferable and more accurate than the method used by the essayists. The "quick method" advocated in some centers is not adequate.

From the essayists' analysis and that of others, it is probable that the optimum therapeutic dose lies in the region of 100 μc/gm. of thyroid tissue in patients with a total thyroid mass of 40 gm. of uniform metabolic activity, a maximum uptake of 60 to 70 per cent and a biological half-life of five and a half to seven days. Although it is the desire and intent to restore the thyrotoxic patient to a euthyroid state with such specific internal irradiation, I see no cause for chagrin if this is not accomplished in 90 to 100 per cent of the cases with one therapeutic dose. Surely the medical profession, and to some degree the laity, have accumulated sufficient knowledge and experience over the years to appreciate that there are few if any sure-fire specifics to always cure the ills of the biologic complex, *genus homo*.

The essayists are to be commended on their labor in the preparation of this analysis of their cases. For all of us, I recommend a guiding philosophy of less hurry and greater accuracy in the study of patients with thyroid disease both with tracer quantities of I^{131} and with therapeutic doses in selected cases. By the ultimate compilation of such cumulative data we may be able to approach wisdom.

William G. Myers, M.D. (Columbus, Ohio): In addition to all of the other variables pointed out by Dr. Seed in this problem of determining dosage, one might wish to consider some of the uncertainties in the radiation chemistry and biochemistry involved in the treatment of the thyroid gland with therapeutic doses of I^{131}. Those of us who attended Doctor Hart's course a few hours ago were reminded that in the final analysis radiation therapy is merely a form of chemotherapy that probably involves chiefly oxidation and reduction reactions. When very pure water is irradiated with high dosages of beta particles, there apparently occurs very little net overall reaction. But, when certain solutes are dissolved in the water, Doctor Hart and others have found that x-rays and beta particles readily produce reaction products. The iodide ion is known to be especially effective in promoting the radiolysis of aqueous solutions by x-rays.

One may hypothesize, then, that in so far as the thyroid gland contains a part of its iodine as iodide ion, it may be thought of as containing its own built-in protective ion that prevents the maximum radiobiological effect of the beta particles emitted by the I^{131}. According to this assumption, the free iodide ions will catalyze the decomposition of water in the thyroid, and the part of the ionizing energy that is dissipated in this radiolysis will not be available for the oxidation-reduction reactions that constitute the radiobiological effects on the cells of the thyroid of the remainder of the ionizing energy released by the I^{131} within the gland.

The variability in the responses of patients to what would appear to be almost the same dose rate and the same total dosage of ionizing radiation in terms of ergs per gram, which Doctor Seed and others of us who use I^{131} in therapy are observing, might be explainable on the basis of variability, in the normal and abnormal physiological states (including those induced by the radiation itself), in the relative proportions of the iodine in the gland in the organic covalent form, and in the concentrations in the form of the iodide ion that then serves to afford varying amounts of radiation protection within the gland itself. This hypothesis might also indicate why it takes such relatively large doses of radiation to produce an effect on the thyroid gland, simply on the basis of its own built-in protective ion.

Some Late Effects in Mice of Ionizing Radiation from an Experimental Nuclear Detonation[1]

JACOB FURTH, M.D., ARTHUR C. UPTON, M.D., KENNETH W. CHRISTENBERRY, M.D., WALTER H. BENEDICT, M.D., and JACK MOSHMAN, Ph.D.

THE FIRST EXPERIMENTAL investigation of the late effects of ionizing radiations from a nuclear detonation in a very large population of mammals (mice) was planned with great care by a team of investigators of the Atomic Energy Commission and the Armed Forces. The animals were placed at various distances from the hypocenter, and the intensity of exposure was monitored by both physical and biological methods.

The radiations from the nuclear detonation were composed predominantly of high-energy gamma rays, with a small component of fast and a still smaller component of slow neutrons, the gamma-neutron ratios increasing with the distance from ground zero. The partial preliminary survey now to be reported was made thirty months after the detonation, when most of the exposed animals and about two-thirds of the controls were dead. While the events to be reported are undoubtedly correct, the figures given are subject to minor revision. The total number of mice studied is about 4,000. All dead animals are being preserved and will be made available to those interested in special studies. The gross anatomical findings are being supplemented by microscopic examination whenever necessary.

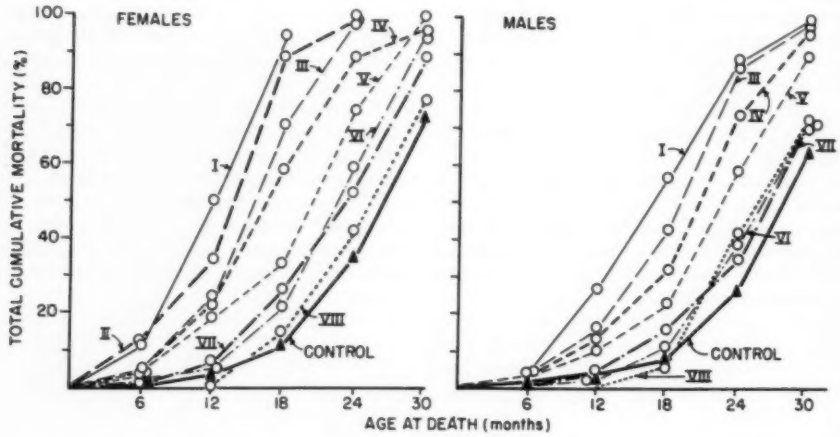

Fig. 1. Cumulative mortality of mice exposed to ionizing radiation from a nuclear detonation. Dose (r): Curve I, 812–841; curve II, 759–785; curve III, 711–733; curve IV, 631–687; curve V, 491–556; curve VI, 287–318; curve VII, 192; curve VIII, 367–424. ▲—, control.
Reproduced from Furth and Upton: Induction of Leukemia by Ionizing Radiation. In Ciba Foundation Symposium on Leukemia Research, London, J. & A. Churchill, 1954.

The mice were of the genetically uniform LAF_1 strain, of both sexes, and six to twelve weeks of age when exposed. After the early mortality rates had been recorded, the animals were transported to Oak Ridge, where they remained individually caged, the cages randomized in one large animal room, until natural death. Sick animals were killed *in extremis*.

[1] From the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. Work performed under Contract W-7405-eng-26 for the Atomic Energy Commission. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.

TABLE I: MORTALITY OF MICE EXPOSED TO IONIZING RADIATION FROM A NUCLEAR DETONATION

Dose (r)	Number Exposed (½♂ and ½♀)	Percentage Mortality					
		Female			Male		
		30 days	1 yr.	30 mo.	30 days	1 yr.	30 mo.
812–932	800	94	97	100	91	94	100
759–785	440	63	74	100	61	74	99
711–733	440	29	47	100	30	41	100
631–687	440	11	34	100	7	20	98
491–556	440	2	19	99	5	16	91
367–424	440	*	*	*	*	*	*
287–318	440	3	11	94	3	8	81
192	220	3	7	95	3	8	86
0	620	3	3	74	0	5	67

* These figures are incomplete due to loss of mice during transportation from field laboratories.

Mortality: The LD50 (30 days) was approximately 755 r in both males and females (Table I). There was some delayed death among the massively irradiated animals during the subsequent few weeks, followed by a period of apparent well-being of the survivors. The following is a tabulation of the delayed mortality among the thirty-day survivors during the ensuing six weeks:

920–841 r	12.0%
812–759 r	3.7%
733–491 r	1.6%
318–192 r	0.3%
Control	1.0%

The cause of death in most of these cases remains obscure. Both delayed mortality and longevity are related to the dose of radiation, as indicated graphically by Figure 1. A significant shortening of the life span resulted even from doses well beneath the threshold for acute lethality. This reduction of longevity was caused mainly by degenerative and neoplastic diseases induced or exaggerated by irradiation.

Cataracts: The first of the late effects noted were opacities of the lens, which made their appearance during the third month postirradiation. Within ninety days after exposure almost all irradiated mice had opacities detectable with the slit lamp; their rate of progression varied directly with the dose (Fig. 2). The mild opacities induced by small doses, up to about 200 r, did not progress to form marked cataracts which presumably would

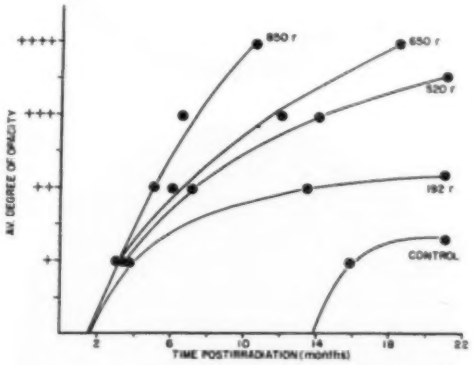

Fig. 2. Opacities of the lens in mice exposed to ionizing radiation from a nuclear detonation.

interfere with vision, whereas opacities caused by larger doses progressed to complete cataract, the rate of progression depending on the dose. For grading of opacities and their relation to dose, see an earlier publication (1).

Iris Defects: Systematic studies of the eye disclosed a progressive loss of iris tissue, beginning with fenestration, which became confluent and terminated in nearly complete loss of iris parenchyma, as illustrated in Figure 3. This change appears to be an abiotrophy that is apparently hereditary in this strain, as mild atrophy of the iris occurred also in aging non-irradiated controls; however, iris atrophy appeared sooner and was more severe following irradiation, in proportion to the dose.

Graying: As early as three months after the detonation graying began to appear,

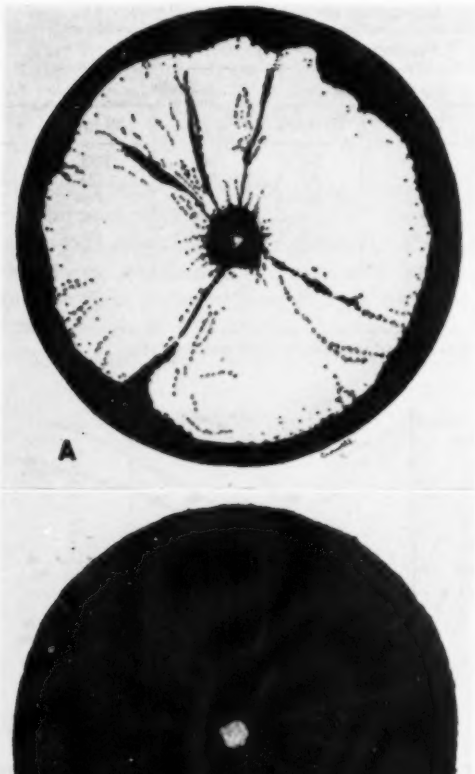

Fig. 3. Severe fenestration of the iris of an irradiated mouse (A) as compared with the normal iris (B).

and it progressed with time, as a function of the dose (Fig. 4). It varied with different anatomical regions and was sufficiently well correlated with the dose to constitute a simple, though only approximate, biological dosimeter (2).

Leukemia: The incidence of thymic lymphoma was greatly elevated by irradiation, in proportion to the dose (Fig. 5). In the groups exposed to more than 700 r, thymic lymphoma occurred with greater frequency among males, and the threshold dose was about 500 r. In females, the threshold dose appears lower, even the 192 r group showing a distinct increase. The earliest cases appeared in the fourth month post-irradiation, and the peak incidence occurred at seven to twelve months after exposure. The greater incidence of thymic lymphomas in males is contrary to earlier experience with most strains of mice exposed to sublethal doses, in which these

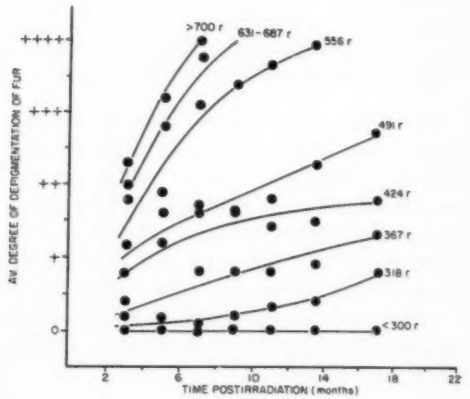

Fig. 4. Depigmentation of fur of mice exposed to nuclear detonation.

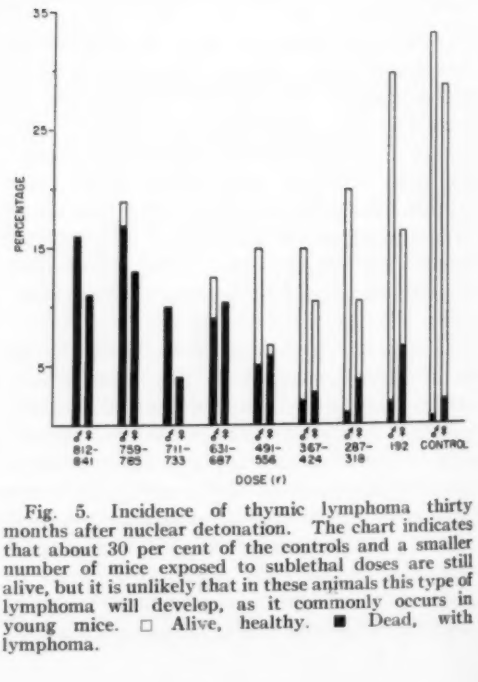

Fig. 5. Incidence of thymic lymphoma thirty months after nuclear detonation. The chart indicates that about 30 per cent of the controls and a smaller number of mice exposed to sublethal doses are still alive, but it is unlikely that in these animals this type of lymphoma will develop, as it commonly occurs in young mice. □ Alive, healthy. ■ Dead, with lymphoma.

tumors were more common in females. Other forms of leukemia, including generalized and other lymphomas, reticulum-cell sarcomas, and, rarely, myeloid leukemias, occurred relatively late in life and were less numerous in the irradiated animals than in the controls (Fig. 6). If correction is made for longevity, however,

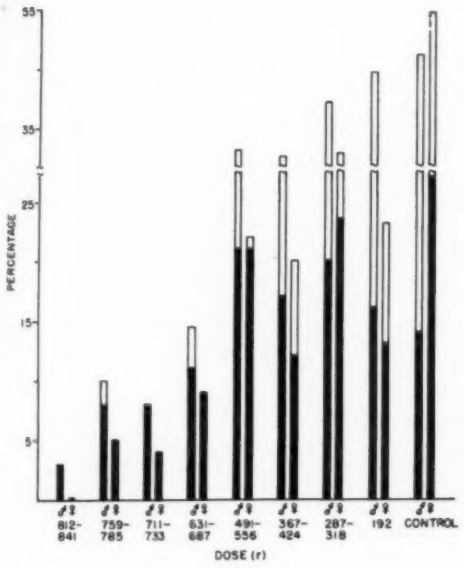

Fig. 6. Incidence of all non-thymic leukemias thirty-two months after nuclear detonation. □ Alive, healthy. ■ Dead, with leukemia.

the incidence of these types of leukemia is slightly higher among the exposed mice. Analysis as per hematologic type will follow.

Ovarian Tumors: The incidence of ovarian neoplasms was very high at all dose levels and very low among the controls (Fig. 7). This was anticipated from earlier studies indicating that, if the threshold dose of about 30 r is exceeded, this neoplasm will develop in most female mice. The ovarian tumors induced included luteomas, granulosa-cell tumors, tubular adenomas of germinal epithelium, cystadenomas, hemangiomas, and most frequently mixtures of these types. The lower incidence of ovarian tumors at high dose levels is related to reduced longevity,

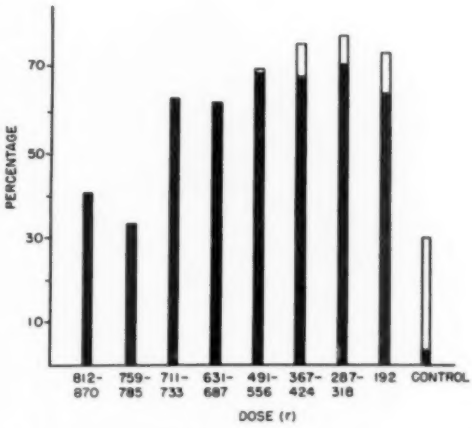

Fig. 7. Incidence of ovarian tumors thirty months after nuclear detonation. □ Alive, healthy. ■ Dead, with tumor.

since their latency period is relatively long (twelve to fifteen months).

Pituitary Tumors: An unanticipated, and perhaps the most significant, finding was the induction of pituitary tumors. These tumors were more common in females (Table II). Their absence in the highest dose groups is readily explained by reduced longevity. If correction is made for survival (Table III), a correlation is found between irradiation dose and pituitary tumor induction. Of all radiation-induced neoplasms, pituitary tumors have the longest latency period, the incidence rate increasing with the length of survival. All pituitary tumors thus far studied were of the chromophobe type. The textbook statement that chromophobe adenomas are non-secreting is probably erroneous. Earlier transplantation studies have indicated that chromophobe adenomas induced by thyroidectomy secrete TSH. Transplantation studies of radiation-induced pituitary tumors indicate that most of them secrete ACTH. In the animals grafted with radiation-induced pituitary tumors, the adrenals were greatly enlarged; lymphopenia, obesity, and diabetes insipidus gave further evidence of ACTH secretion. In the animals in which the tumors were induced by irradiation, the adrenals were atrophic, and adrenal

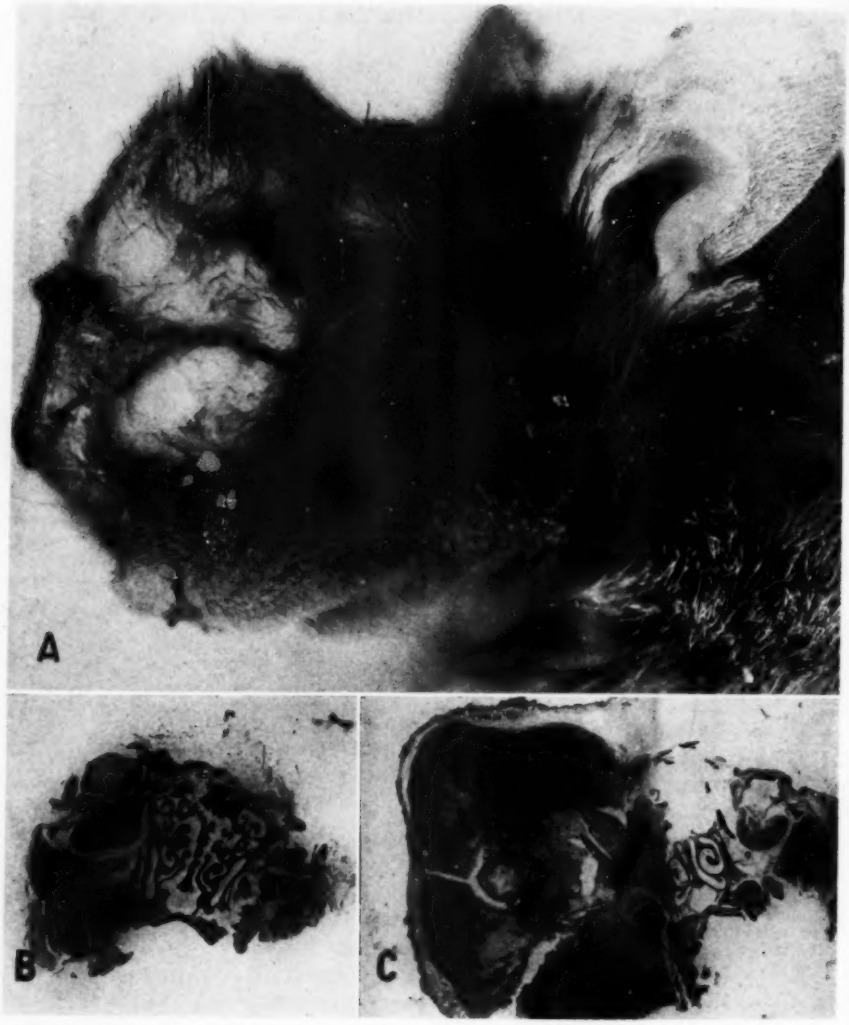

Fig. 8. Harderian gland tumors. A. A large neoplasm covering the right side of the face. B. Cross section of the skull, showing a smaller tumor in the orbit. C. Tumor infiltrating the skull shown in cross section.

TABLE II: INCIDENCE OF PITUITARY TUMORS THIRTY MONTHS AFTER EXPOSURE TO NUCLEAR DETONATION

Dose (r)	Female				Male			
	Per Cent Surviving*		Pituitary Tumor		Per Cent Surviving*		Pituitary Tumor	
	12 mo.	30 mo.	No.	Per cent†	12 mo.	30 mo.	No.	Per cent†
812–932	60	0	0	0	64	0	0	0
759–785	66	0	0	0	63	2	3	5.2
711–733	75	0	14	11.9	85	0	2	1.5
631–687	75	0	18	12.3	86	4	8	4.5
491–556	83	1	29	16.2	89	10	4	2.2
367–424	85	8	10	15.2	95	13	0	0
287–318	92	7	17	8.7	95	19	5	2.5
192	95	10	8	7.8	95	28	0	0
0	100	27	5	1.7	95	33	0	0

* Of those surviving thirty days postirradiation. † Of those surviving twelve months.

TABLE III: PITUITARY TUMOR INCIDENCE IN FEMALES IN RELATION TO TIME AFTER IRRADIATION

Dose (r)	No. of Females Dying After Indicated Number of Months Postirradiation							
	7–12		13–18		19–24		25–30	
	No. with Tumor / No. Alive*	%	No. with Tumor / No. Alive*	%	No. with Tumor / No. Alive*	%	No. with Tumor / No. Alive*	%
711–733	0/152	0	4/120	3.3	10/47	21.3	0/1	0
631–687	1/187	0.5	5/149	3.3	9/80	11.2	4/20	20.0
491–556	2/206	1.0	2/179	1.1	17/146	11.6	10/56	17.8
367–424	0/78	0	2/78	2.6	4/66	6.1	4/45	9.1
287–318	0/210	0	1/213	0.5	8/170	4.7	8/89	9.0
192	0/106	0	0/106	0	3/79	3.8	5/51	9.8
0	0/299	0	0/294	0	0/270	0	5/188	2.6

* At beginning of indicated period.

atrophy, itself a late effect of irradiation, was probably the inciting cause of the pituitary tumors.

Harderian Gland Tumors: Another unexpected neoplasm observed in the irradiated mice is adenocarcinoma of the harderian gland of the orbit (Fig. 8). This is a locally invasive neoplasm, often obliterating the orbit, invading the skull and adjacent soft tissues. It was found more commonly in the low-dose groups (Table IV), probably because of its long latent period (fifteen to seventeen months). The absence of harderian gland tumors in the higher-dose groups can be explained by the earlier death of most mice at these levels and by the relatively small number surviving such doses, the induction rate of these tumors being very low and apparently not dose-dependent. Thus far, no such tumors have been observed in the controls, and to our knowledge they have not hitherto been reported in mice. Their induction mechanism is unknown.

TABLE IV: INCIDENCE OF HARDERIAN GLAND TUMORS: ANALYSIS AT THIRTY MONTHS POSTIRRADIATION

Dose (r)	Female		Male	
	No.	Per Cent*	No.	Per Cent*
812–932	0	0	0	0
759–785	0	0	0	0
711–733	2	1.7	4	3.1
631–687	5	3.3	2	1.1
491–556	3	1.7	5	2.7
287–318	6	2.9	4	1.9
192	3	3.0	2	1.9
0	0	0	0	0

* Of those surviving twelve months postirradiation.

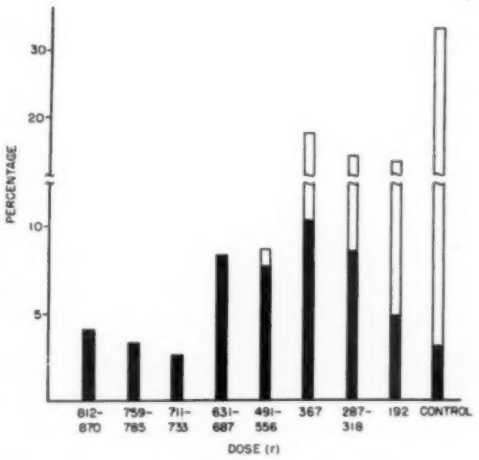

Fig. 9. Incidence of mammary gland tumors in females thirty months after nuclear detonation. □ Alive, healthy. ■ Dead, with tumor.

Mammary Gland Tumor: Mammary tumors were very rare in males; their incidence in females was moderately increased by irradiation in the dose groups 192–687 r (Fig. 9). Failure to demonstrate an increase at higher dose levels was due to reduced longevity. The neoplasms which occurred early were predominantly adenomas and adenocarcinomas, while those developing later were sarcomas, as has been described by Lorenz *et al.* (3). Furthur analysis of these tumors with respect to the various histologic types and their relation to hyperestrogenization by coexist-

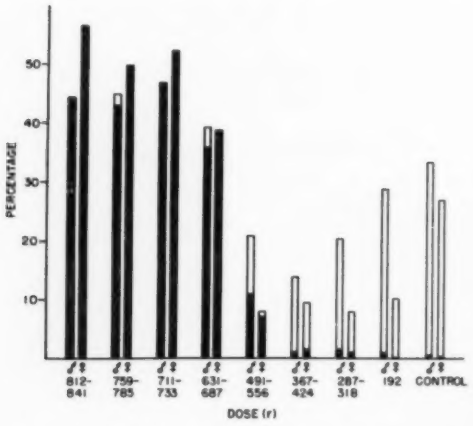

Fig. 10. Incidence of nephrosclerosis thirty months after nuclear detonation. □ Alive, healthy. ■ Dead, with nephrosclerosis.

ing ovarian tumors, as noted earlier (3), will follow.

Other Tumors: Adenomas of the lung, liver, adrenal, and kidney, and carcinomas of these and other organs have been observed but are not yet analyzed.

Nephrosclerosis: Fatal degeneration of the kidney occurred frequently at dose levels above 500 r, was very rare at lower dose levels, and is absent thus far in controls (Fig. 10). The lesion is most conspicuous in the glomerulus and consists of deposition of homogeneous material in the glomerular tufts, ultimately resulting in their obliteration (Fig. 11). This material takes the collagen stains; associated with it there is sclerosis of arterioles but not of larger arteries. There is also diffuse interstitial fibrosis with atrophy of the organ; gross diagnosis can be made from atrophy, fine granularity, and brown discoloration of the kidneys. Inflammatory cells are absent. The process is always bilateral and is frequently associated with generalized edema.

The pathogenesis of this nephrosclerosis remains to be determined. Others have described nephrosclerosis in man after massive local irradiation and in animals after supralethal doses of total-body irradiation combined with a protective agent (4). The lesions are unlike those of glomerulonephritis and pyelonephritis but could be the consequence of delayed vascular damage produced by irradiation.

SUMMARY AND COMMENTS

Exposure of a large population of mice to nuclear detonation under well controlled conditions confirmed earlier findings on the late effects of ionizing irradiation and led to the discovery of additional late effects. The frequency, time of onset, and severity of the radiation-induced changes follow patterns characteristic for each change, species, and strain.

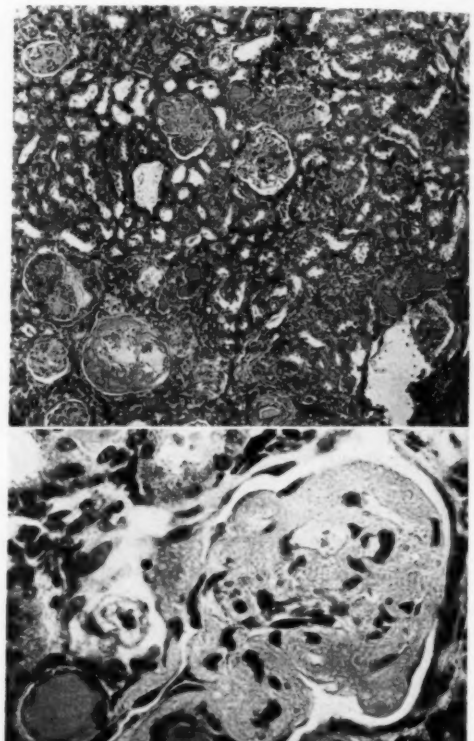

Fig. 11. Characteristic sclerosis of glomerular tufts and renal arterioles, with interstitial fibrosis, in massively irradiated mouse dying eighteen months post-irradiation.

The non-neoplastic changes, such as cataract, nephrosclerosis, and atrophy of

the iris, develop and progress in direct proportion to the dose; they may result from local radiation damage of these organs. Certain neoplasms, however, such as those of the ovary, pituitary gland, and breast, may be induced not by a direct mutagenic effect of irradiation but by an "imbalance" of the normal physiologic regulatory mechanisms. For example, development of ovarian tumors appears to be related to a disturbance of the ovary-pituitary relation, that of pituitary tumors to adrenal-pituitary "imbalance," and that of breast tumors to deranged secretions of gonadal hormones. The work of others indicates that leukemia too is induced by some complex mechanism, probably involving an alteration of the hemopoietic reticulum and secondary modifiers. The sequence of events is precisely reproducible, yet the exact mechanisms by which these changes are initiated and realized are unknown.

While it is conceivable that specific carcinogenic viruses are activated by irradiation, none has been demonstrated thus far, and it is unlikely that all neoplasms are virus-induced. For ovarian tumors, such a pathogenesis would require the existence of viruses specific for each cell type present in almost all normal mice. Should such filterable agents exist, they would be better conceived as related to normal cellular reproduction than as infectious submicroscopic agents.

The reduction of longevity in proportion to the dose and the observed hastening of the development of many neoplasms by irradiation suggest that ionizing irradiation accelerates the aging process. Neither aging nor radiation damage is well understood, however; the study of both and their possible interrelation is worth pursuing. Noteworthy in this connection is the observed hastening by irradiation of hereditary iris atrophy, cataract formation, vascular and interstitial sclerosis and their late sequelae, and nephrosclerosis. It is difficult to dissociate the aging process from that of injury, and most alterations attributed to aging may be those of accumulated injury. Neoplasms frequently arise in aging or injured organs. Isolated cells grown in tissue cultures do not appear to age.

Further study of the late effects of irradiation, in which different strains of mice and different species are used, will enlarge the store of basic information bearing on the process of aging and neoplasia. Data obtained thus far amply indicate the wealth of basic knowledge which may be acquired through study of the late effects of ionizing irradiation.

ACKNOWLEDGMENT: The planning, development of laboratories and exposure equipment, breeding, handling, and exposure of the animals, and the initial studies were carried on over a period of two years by members of the staffs of the Naval Medical Research Institute, Los Alamos Scientific Laboratory, U. S. Naval Radiological Defense Laboratory, and the Division of Biology and Medicine of the Atomic Energy Commission. We are particularly indebted to Drs. S. Warren, Chief of the Division of Biology and Medicine; G. V. LeRoy, Director of the Biomedical Program; W. Langham, Deputy Director; and Captain R. H. Draeger, MC, USN, who supervised the development of field biological installations and exposure equipment.

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(Para el sumario en español, véase la página siguiente)

SUMARIO

Algunos Efectos Tardíos en los Ratones de la Radiación Yonizante Procedente de Una Detonación Nuclear Experimental

Una población numerosa de ratones (unos 4,000) fué expuesta a una detonación nuclear, cuyas radiaciones estaban compuestas predominantemente de rayos gamma de alta energía, con un pequeño componente de neutrones veloces y otro todavía más pequeño de neutrones lentos. Preséntase aquí un estudio preliminar parcial ejecutado a los treinta meses de la detonación, para cuya fecha la mayor parte de los animales expuestos y unas dos terceras partes de los testigos habían muerto.

Las observaciones confirmaron hallazgos anteriores acerca de los efectos tardíos de la irradiación yonizante y condujeron al descubrimiento de nuevos efectos tardíos. La frecuencia del tiempo de la iniciación y la gravedad de las alteraciones provocadas por la radiación se conformaron a patrones típicos para cada alteración, especie y cepa.

Las alteraciones no neoplásicas, tales como catarata, nefrosclerosis y atrofia del iris, se presentaron y avanzaron en razón directa a la dosis; pueden provenir de la lesión irradiatoria local de dichos órganos. Por otro lado, la mayor incidencia de linfoma tímico y de tumores ováricos, hipofisarios y mamarios parece deberse, no a efecto mutágeno directo de la radiación, sino a desequilibrio de los mecanismos reguladores fisiológicos normales.

Un hallazgo inesperado fué el adenocarcinoma de la glándula orbitaria de Harder. La degeneración letal del riñón fué frecuente a dosis de tenores superiores a 500 r.

La disminución de la longevidad en proporción a la dosis y la aceleración del desarrollo de muchas neoplasias por la irradiación sugieren que la irradiación yonizante acelera el proceso del envejecimiento. Es difícil disociar este proceso del de la lesión, y la mayor parte de las alteraciones imputadas al envejecimiento tal vez correspondan a la acumulación de lesiones.

DISCUSSION

Leonidas D. Marinelli, M.A. (Lemont, Ill.): The very careful observations of Dr. Furth bring to my mind a set of experiments published a short time ago by Dr. L. Bennett and co-workers, also on the subject of late effects of radiation, but on animals irradiated under anoxic conditions. I think that a comparison of the type and frequency of damage observed in the two instances should be most interesting and instructive.

Dr. Furth (*closing*): Dr. Marinelli's comment on the induction of neoplasms by enabling the animals to withstand higher dosages through application of some protector is well taken. In protected animals receiving very large doses the development of a number of neoplasms unknown among unprotected animals has been reported. Something else happened: nephrosclerosis developed. The latter has not been described until today among animals exposed without shielding or protection.

In conclusion, we ask ourselves where do we go from here. The purpose of the animal experimentation is to predict what might occur in man, present reproducible conditions, understand their pathogenesis, and learn about protective mechanisms. Briefly, we hope that this report is merely an introduction to research aimed at learning about and counteracting the late harmful effects of ionizing irradiations.

EDITORIAL

X-Ray Movies

The availability of fast lenses, films, and screens, and the new developments in image intensification put x-ray movies within the reach of almost any radiologist who is inclined to make them. It is timely, therefore, to think about the conditions under which this expensive, difficult, potentially dangerous, and time-consuming technic may be applied effectively, and the purposes for which it may be used profitably.

To be useful, an x-ray movie must portray an event with the following characteristics: (a) short duration, so that the exposure of the patient is not unduly high; (b) rapid movement of parts, so that slowed motion will bring out details not appreciable at normal rates; (c) predictable time of occurrence; (d) repetitive or cyclical nature, so that the study of one cycle can give information about all cycles, as in the flow of blood through the heart. The object to be shown must be small enough to be encompassed by the fluoroscopic screen used and its motion must either be so limited that it does not move off the screen or slow enough so that the movement can be followed by the entire filming unit. The anatomical part filmed must be sufficiently radiolucent that adequate exposure of the film can be achieved in a short enough time so that flickering of the image may be avoided. The patient must not be overexposed. The equipment must be able to bear the electrical and heat loads put upon it. The parts of the body to be studied must have sufficient natural or artificially alterable contrast so that motion between parts can be distinguished roentgenologically.

If an anatomical part to be studied lies in a radiolucent ("thin") part of the body (neck, chest, extremity), it may be filmed by means of a screen-lens combination without image intensification. However, even with "thin" parts, the brightness of the image is so low that fast, grainy screens and films must be used, and the film must be developed to high speed and contrast with consequent further increase in grain size, if even a usable image is to be obtained.

These factors combine to degrade the detail of the resultant film to such an extent that bony trabecular patterns, for instance, are poorly seen or not seen at all on 16-mm. film. With increase in film size to 35 or 70 mm., the ratio of film-grain size to image size is improved, and such detail as trabecular patterns in bone can be made out. The screen-lens system has the advantage of relative cheapness (in terms of "kilobucks") and the possibility of using large screen sizes.

If the anatomical part to be studied is small (less than 5 inches in projected diameter), then the image amplifier or intensifier tubes may be used. When the image is made bright enough through the use of such an intensifier, finer grain screens, films, and development may be used, with consequent marked improvement in the image. Satisfactory images may be obtained through even "thick" parts of the body, such as the head and abdomen. However, the limitation of size is a very severe one indeed.

If the anatomical part to be studied is larger than 5 inches in projected diameter, and lies in a "thick" part of the body, then the television method of image intensification must be used, with an attendant high cost of initial installation and maintenance.

Added to these fundamental restrictions on the effective use of x-ray movies, are

the problems and space limitations encountered in processing, drying, printing, viewing, and storing long strips of film, with which the "standard" x-ray department is not equipped to cope. These must be taken into account before embarking upon this fascinating procedure. The processing should be undertaken in the x-ray department or in a very closely associated photographic laboratory willing to give high priority to these films, if it is to be satisfactory with regard to expense, rapidity, and quality of result. The time consumed in viewing the movie film is almost always longer than would be spent in studying static films or the fluoroscopic image for a similar examination. This viewing time must be added to the large amount of time required to make the movies.

Is there, then, in view of all the factors and difficulties that enter into the making of x-ray movies, a place for them in the modern x-ray department? It will be found that three fields of usefulness exist: they are, in order of their decreasing importance, (a) teaching, (b) research, and (c) patient-service.

There are many things that come to mind that might be put on movie film strips. For example, motion of parts of the gastrointestinal tract and diaphragmatic and joint motion. In general, these motions are slow enough to be demonstrated on ordinary serial films, and they can be seen adequately with present fluoroscopic equipment. To what purpose, then, would one transcribe them on film? It would seem that the main reason would be to serve the purpose of teaching these motions to medical students without the necessity of exposing them to radiation and requiring the time of a radiologist for such instruction. The changes in stomach or small bowel activity as a demonstration of the action of certain drugs might help in the teaching of pharmacology. However, films such as these might well be produced in one center and prints be made available to many teaching centers.

X-ray movies are of real value for research, teaching, and patient service in angiocardiography, particularly in the study of congenital heart disease in children, in the study of the movement of the larynx and pharynx during the act of swallowing, and in the study of bladder movement during urination. These are motions which are so rapid that they require "slow motion" for study; they need to be studied as continuous changes, over and over again, and they are predictable in time. The contrasts are sufficient for adequate visualization.

Undoubtedly other areas of usefulness will become evident as research and thought on this subject continue, and when larger image amplifier tubes become available. However, the field will probably always remain relatively limited because of the fundamental problems involved, and the process will always be an expensive one. Before a radiologist embarks upon a program of producing x-ray movies, it would be well for him to consider thoroughly the various aspects of the undertaking and to visit an installation that is making them. The field of x-ray movie production for research and teaching is still a fertile one. If a radiologist wants to produce movies for these purposes, he will find it worth doing. If he wants them for patient-service, the yield of worth-while results will be limited. The greatest need today is an image intensifier tube about 12 inches in diameter. EARL R. MILLER, M.D.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

FORTIETH ANNUAL MEETING

Biltmore Hotel, Los Angeles, Calif., Dec. 5–10, 1954

PRELIMINARY PROGRAM

Monday, December 6

OPENING SESSION: 10:30 A.M.–12:00 M.

SECTION A

William E. Costolow, M.D., First Vice-President Presiding

Greetings. ARLO A. MORRISON, M.D., President, California Medical Society.

Presidential Address: History of the Radiological Society of North America. EUGENE P. PENDERGRASS, M.D.

Radiology as a Profession. LOWELL S. GOIN, M.D.

Radiation Control Legislation in the United States. LAURISTON S. TAYLOR, PH.D.

SECTION AB: 2:00–4:30 P.M.

Thomas B. Bond, M.D., President-Elect, Presiding

Historical Lecture: The Life of Dr. Augustus W. Crane. HOWARD P. DOUB, M.D.

Nephrotomography. JOHN A. EVANS, M.D.

Fires and Explosions in Anesthesia. JOHN B. DILLON, M.S., M.D.

Metastatic Malignant Lesions of the Testis. ORLISS WILDERMUTH, M.D.

Symposium in Cineradiography. EARL R. MILLER, M.D., *Moderator;* H. STEPHEN WEENS, M.D., ROBERT F. RUSHMER, M.D., GEORGE H. RAMSEY, M.D., AND RUSSELL H. MORGAN, M.D.

BUSINESS MEETING: 4:30 P.M.

Tuesday, December 7

SECTION A: 10:30 A.M.–12:00 M.

W. Edward Chamberlain, M.D., Presiding

Gastro-Esophageal Incompetence, Partial Intrathoracic Stomach, and Vomiting in Infancy. FREDERIC N. SILVERMAN, M.D.

Chronic Ulcerative Colitis in Children. JOHN R. HODGSON, M.D., AND R. L. J. KENNEDY, M.D.

Subendocardial Fibroelastosis: Roentgen Appearance and Differential Diagnosis. WILLIAM R. EYLER, M.D., ROBERT F. ZIEGLER, M.D., AND JAMES J. SHEA, M.D.

Neuromuscular Disorders of the Urinary Tract in Children. ROBERT P. ALLEN, M.D.

The Normal Interpediculate Space in the Spines of Infants and Children. WAYNE A. SIMRIL, M.D., AND DONALD THURSTON, M.D.

The Early Recognition of Premature Cranial Synostosis. JOHN W. HOPE, M.D., EUGENE B. SPITZ, M.D., AND HARRY W. SLADE, M.D.

Congenital Abnormalities of the Feet. LAWRENCE A. DAVIS, M.D., AND WILLIAM HATT, M.D.

SECTION AB: 2:00–4:30 P.M.

Robert S. Stone, M.D., Presiding

Evaluation of Methods of Measuring the Accumulation of I-131 by the Thyroid Gland. JOHN P. STORAASLI, M.D., WM. J. MACINTYRE, M.D., HYMER L. FRIEDELL, M.D., AND KEITH E. WEIGLE, JR., M.D., with Discussion by ROBERT ROBBINS, M.D.

Results of Treatment of Thyrotoxicosis with Radio-Iodine. RICHARD H. CHAMBERLAIN, M.D., K. F. BALLS, M.D., EDWARD ROSE, M.D., ROBERT O. GORSON, M.S., AND HENRY C. BLOUNT, JR., M.D.

Treatment of Multiple Myeloma with Radioactive Iodine. JOSEPH P. KRISS, M.D., HOWARD R. BIERMAN, M.D., AND SYDNEY F. THOMAS, M.D.

Follow-up Study of 100 Cases of Carcinoma of the Prostate Treated with Radioactive Gold. H. DABNEY KERR, M.D., R. H. FLOCKS, M.D., H. B. ELKINS, M.D., DAVID A. CULP, M.D., TITUS C. EVANS, PH.D.

Replacement of Intracavitary Radium Capsules in the Treatment of Carcinoma of the Cervix by a Single Radioactive Gold-198 Pellet (Better Shielding of the Rectum and Bladder). MICHEL TER-POGOSSIAN, PH.D., AND ALFRED I. SHERMAN, M.D.

Implantation of Radioisotopes in Nylon Ribbons. ULRICH K. HENSCHKE, M.D., PH.D.

The Late Effects of Beta Radiation on the Eye. GEORGE R. MERRIAM, JR., M.D.

BUSINESS MEETING: 4:30 P.M.

SECTION B: 10:30 A.M.–12:10 P.M.

Lauriston S. Taylor, Ph.D., Presiding

Radiation Protection Measures in a University. TITUS C. EVANS, PH.D.

Radiation Hazard Control in Hospitals. G. FERLAZZO, B.S., A. JACOBSON, B.S., M. BUSHMAN, AND T. NICHOLSON.

Radiation Protection in the Atomic Energy Industry—A Ten-Year Review. H. M. PARKER, M.Sc., F. INST. P.

Radiation Hazards Associated with Particle Accelerators. HANSON BLATZ, E.E., LEONARD R. SOLON, M.A., AND J. E. MCLAUGHLIN, M.A.

Radiation Protection from Cobalt-60 and Cesium-137 Teletherapy Units. MARSHALL BRUCER, M.D.

Cobalt-60 Protection Design. C. B. BRAESTRUP, B.S., AND R. T. MOONEY, M.Sc.

THE CARMAN LECTURE: 8:30 P.M.

Roentgen Examination of the Acute Abdomen

BARTON R. YOUNG, M.D.

introduced by

W. Edward Chamberlain, M.D.

Wednesday, December 8

SECTION A: 10:30 A.M.–12:00 M.
J. Rush Shull, M.D., Third Vice-President, Presiding

Insulin Induced Hypermotility in the Roentgen Examination of the Stomach and Duodenum. GEORGE JACOBSON, M.D., KENNETH A. HEITMANN, M.D., DENIS C. ADLER, M.D., AND DERRILL D. WATSON, M.D.

Barium Suspended in Hydrogen Peroxide for the Demonstration of Ulcerated Lesions of the Esophagus and Stomach. CESARE GIANTURCO, M.D., AND GEORGE A. MILLER, M.D.

The Ileum Following Colectomy. SAMUEL H. MADELL, M.D., AND ROSS GOLDEN, M.D.

Roentgen Abnormalities of the Large and Small Intestine Associated with Prolonged Cathartic Ingestion. NORMAN HEILBRUN, M.D., AND CHARLES BERNSTEIN, M.D.

Benign and Malignant Tumors of the Duodenum. EUGENE FREEDMAN, M.D., MARCELLA SAVA, M.D., AND MARCUS RABWIN, M.D.

Pancreatography: Technics, Principles and Observations. M. H. POPPEL, M.D., HENRY DOUBILET, M.D., AND JOHN H. MULHOLLAND, M.D.

Roentgen Aspects of Internal Biliary Fistula with Particular Reference to Gallstone Obstruction of Pylorus and Small Bowel. MAURICE TATELMAN, M.D., AND RAYMOND J. SCREEN, M.D.

SECTION AB: 2:00–5:00 P.M.
Lowell S. Goin, M.D., Presiding

Bone Lesions: Their Diagnosis and Treatment.[1] PHILIP J. HODES, M.D., *Moderator;* LAUREN V. ACKERMAN, M.D., *Pathologist;* J. VERNON LUCK, M.D., *Orthopedist;* L. Henry GARLAND, M.D., *Radiologist.*

SECTION B: 10:30 A.M.–12:10 P.M.
W. K. Sinclair, Ph.D., Presiding

Calorimetric Method of Measuring Energy Locally Absorbed. H. E. JOHNS, PH.D., F.R.S.C., AND J. P. BERNIER, M.Sc.

Absolute Calibration of a Telecobalt Unit. S. GENNA, M.S., AND J. S. LAUGHLIN, PH.D.

Gamma Ray Output of Radium. FRANK H. ATTIX, M.S., HAROLD O. WYCKOFF, PH.D., AND LEROY DELAVERGNE, B.S.

Calibration and Dosage Determination in Beta-Gamma-X-ray Film Dosimetry at ORNL. EDWIN D. GUPTON, B.S.

Effect of Kilovoltage and Grid Ratio on Subject Contrast in Radiography. H. E. SEEMANN, PH.D., AND H. R. SPLETTSTOSSER, B.S.

Absorption in Different Tissues of Cobalt-60 Gamma Radiation and Roentgen Rays with Half-Value Layers Varying from 1 mm. Al to 5 mm. Cu. LILLIAN E. JACOBSON, M.A., F.A.C.R., AND ISABELLE S. KNAUER, M.A.

Thursday, December 9

SECTION A: 10:30 A.M.–12:00 M.
John D. Camp, M.D., Presiding

Discography in the Evaluation of Lumbar Disk Lesions. JACK FRIEDMAN, M.D., AND Meyer Z. Goldner, M.D.

The Myelogram in Avulsion of the Brachial Plexus. ALBERT A. RAYLE, JR., M.D., BRIT B. GAY, JR., M.D., AND JASON L. MEADORS, M.D.

Spinal Osteomyelitis Associated with Urinary Tract Infections. TED F. LEIGH, M.D., ROBERT P. KELLY, M.D., AND H. STEPHEN WEENS, M.D.

The Syndrome Associated with Mucocele of the Sphenoid Sinus. FRED R. TINGWALD, M.D., AND HOWARD M. SIMON, JR.

Mastoids. GILBERT R. OWEN, M.D.

Hemispherectomy. An Analysis of Etiology, Indications and Results. EUGENE B. SPITZ, M.D.

SECTION AB: 2:00–4:30 P.M.
Ira H. Lockwood, M.D., Presiding

The Care of the Advanced Cancer Patient. *Moderator,* THEODORE P. EBERHARD, M.D.

Cancer of the Larynx. ROBERT ROBBINS, M.D.

Cancer of the Lung. ROBERT J. BLOOR, M.D.

Cancer of the Breast. SIMEON T. CANTRIL, M.D.

Malignant Melanoma. ROY R. GREENING, M.D.

Cancer of the Cervix. JUAN A. DEL REGATO, M.D.

Chemotherapy. HOWARD R. BIERMAN, M.D.

Neurological Surgery. EUGENE B. SPITZ, M.D.

SECTION B: 10:30 A.M.–12:10 P.M.
Edith H. Quimby, D.Sc., Presiding

Energy Distribution of Secondary Electrons Subsequent to X-Irradiation in Tissue Equivalent Media. J. E. ROBINSON, M.A., AND MICHEL TER-POGOSSIAN, PH.D.

Contact Applicators for Beta Irradiation of the Cornea. W. K. SINCLAIR, PH.D.

The Dosimetry of Beta Sources in Tissue. ROBERT LOEVINGER, PH.D.

Application of Automatic Computing Machines to Radiation Treatment Planning. KIA-CHI TSIEN.

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[1] See the Bone Tumor Seminar, constituting Part II of this issue of RADIOLOGY.

Isodose Curves for 22.5-mev X-Rays. J. OVADIA, PH.D., G. S. SHAPIRO, M.S., AND W. ERNST, M.A.

Isodose Curves for Superficial Therapy. E. DALE TROUT, SC.D., JOHN P. KELLEY, B.S., AND ARTHUR C. LUCAS, B.S.

ANNUAL BANQUET: 7:00 P.M.

Friday, December 10

SECTION A: 10:30 A.M.–12:15 P.M.
Clarence E. Hufford, M.D., Presiding

Radiating Spicules, A. Non-Specific Manifestation of Bone Disease. OTTO H. GRUNOW, M.D.

Evaluation of Placentography in Late Bleeding of Pregnancy. EUGENE J. MCDONALD, M.D.

Planigraphy in the Differential Diagnosis of the Pulmonary Nodule. LEO G. RIGLER, M.D., AND E. ROBERT HEITZMAN, M.D.

Evaluation of Intrapulmonic Adenopathy in Sarcoidosis. RUSSELL WIGH, M.D., AND ELEANOR D. MONTAGUE, M.D.

Co-existent Pulmonary Tuberculosis and Carcinoma. HARRY HAUSER, M.D., AND NORMAN M. GLAZER, M.D.

Pneumonitis Following Radiation Therapy of Cancer of the Breast by Tangential Technic. RALPH PHILLIPS, M.D., FLORENCE C. H. CHU, M.D., JAMES J. NICKSON, M.D., AND J. G. MCPHEE, M.D.

Roentgen Pathological Changes of the Portal Venous System in Obstruction of the Intrahepatic Block Type. FRANCIS F. RUZICKA, JR., M.D., GUNTHER A. DOEHNER, M.D., LOUIS M. ROUSSELOT, M.D., AND GEORGE HOFFMAN, M.D.

An Evaluation of Portal Venography Performed by Intrasplenic Injection of Contrast Material (Splenography). FREDERICK J. BONTE, M.D., AUSTIN S. WEISBERGER, M.D., CARLO PIAVELLO, M.D.

Hypaque, a New Urographic Contrast Medium. EVERETT E. SEEDORF, M.D.

SECTION B: 10:30 A.M.–12:10 P.M.
Henry S. Kaplan, M.D., Presiding

Some Physical Technics of Interest to the Study of Chronic Radium Toxicity. L. D. MARINELLI, M.A., R. E. ROWLAND, M.S., C. E. MILLER, PH.D., AND P. F. GUSTAFSON, M.S.

Measurement of Radium in Living Humans; Intake and Retention at Natural Levels. A. F. STEHNEY, PH.D., AND H. F. LUCAS, B.S.

Early Biological Effects of Internally Deposited Radioactive Elements. J. Z. BOWERS, M.D., J. DOUGHERTY, M.D., R. BAY, D.V.M., P. KEYANONDA, M.D.

On the Role of Radiothorium in Radium Poisoning. M. A. VAN DILLA, PH.D., and B. J. STOVER, PH.D.

Production of Cataracts in Animals by X-rays and by Fast Neutrons. P. J. LEINFELDER, M.D., TITUS C. EVANS, PH.D., AND E. F. RILEY, PH.D.

The Effect of Oxygen on Radiosensitivity of Mammalian Cells. ALAN D. CONGER, PH.D.

ANNOUNCEMENTS AND BOOK REVIEWS

RADIOLOGICAL SOCIETY OF GREATER CINCINNATI

Newly elected officers of the Radiological Society of Greater Cincinnati are Chapin Hawley, M.D., President; Emanuel Levin, M.D., Vice-President; William R. Dickens, M.D., Cincinnati General Hospital, Cincinnati 29, Secretary-Treasurer.

RADIOLOGICAL SOCIETY OF HAWAII

The following officers were elected by the Radiological Society of Hawaii at a recent meeting. Peter J. Washko, M.D., President; Philip S. Arthur, M.D., Vice-President; H. C. Chang, M.D., 1282 Emma St., Honolulu 13, Secretary-Treasurer; Louis L. Buzaid, M.D., Councilor to the American College of Radiology.

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY

A joint meeting of the Radiological Society of Greater Kansas City and the Radiological Society of Kansas is scheduled for Feb. 14–17, 1955. The guest speakers will be James W. J. Carpender, M.D., Chicago, Ill.; Lauren V. Ackerman, M.D., St. Louis, Mo.; Mr. James Stober, technical director, Keleket X-Ray Corporation; Philip J. Hodes, M.D., Philadelphia, Penna.; William H. Beierwaltes, M.D., and John F. Holt, M.D., Ann Arbor, Mich.; Carl L. Gillies, M.D., Iowa City, Iowa; Carl C. Birkelo, M.D., Detroit, Mich., and Bertram V. A. Low-Beer, San Francisco, Calif. Further information may be obtained from Galen M. Tice, M.D., University of Kansas Medical Center, Kansas City 3, Kans.

CENTRAL OHIO RADIOLOGICAL SOCIETY

Officers recently elected by the Central Ohio Radiological Society are: George F. Jones, M.D., of Lancaster, President; Howard W. Bangs, M.D., of Columbus, Vice-President; Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus, Secretary-Treasurer.

The Society meets at the Fort Hayes Hotel, Columbus, at 6:30 P.M., the second Thursday, October, November, February, April, and June.

TENNESSEE RADIOLOGICAL SOCIETY

At a recent meeting of the Tennessee Radiological Society held in conjunction with the State Medical Association meeting in Nashville, the following officers were elected: J. Marsh Frère, M.D., Chattanooga, President; John M. Wilson, M.D., Memphis, Vice-President; George K. Henshall, M.D., 311 Medical Arts Building, Chattanooga 3, Secretary-Treasurer. The guest speaker at the meeting was Dr. C. A. Good.

SEVENTH ANNUAL CONFERENCE ON ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY

The Seventh Annual Conference on Electrical Techniques in Medicine and Biology will be held at the Morrison Hotel, Chicago, Ill., Nov. 10–12, under the sponsorship of the American Institute of Electrical Engineers, Institute of Radio Engineers, and Instrument Society of America.

The Wednesday (Nov. 10) morning session will be devoted to papers on The Circulation and Cardiology, Wednesday afternoon to Electrical Properties of Biological Materials, Thursday afternoon to X-Rays and Instrumentation. A dinner meeting is scheduled for the evening of Nov. 10, with Dr. T. E. Allibone, Director of Research, of the Associated Electrical Industries of Great Britain, and a Fellow of the Royal Society, as guest speaker.

Thursday morning has been reserved for a visit to the Argonne Cancer Research Hospital and Friday morning for a visit to the Argonne National Laboratory. Citizens of countries other than the United States must give three weeks notice through the Conference Chairman so that admission to the Argonne National Laboratory may be arranged.

Mr. E. Dale Trout, 4855 Electric Ave., Milwaukee 1, Wisc., is Chairman of the Conference, and Mr. G. A. Morton, of David Sarnoff Research Center, Princeton, N. J., is chairman of the Publicity Committee.

INTERNATIONAL COURSE ON TOMOGRAPHY

The third International Course on Tomography will be held at the Radiology Institute, University of Genoa, Italy, under the direction of Prof. Alessandro Vallebona, in the Fall of 1955. The course will cover a period of ten days and will deal particularly with recent progress in tomographic methods. Any who are interested in attending are asked to communicate with Prof. Vallebona, Ospedali Civili S. Martino, Padiglione Sommariva, Genoa, Italy. This will entail no obligation.

FOURTEENTH JAPAN MEDICAL CONGRESS

A preliminary announcement has been received of the Fourteenth Japan Medical Congress to be held in Kyoto, April 1–5, 1955. Among the numerous participating organizations are the Nippon Societas Radiologica and the Japanese Cancer Association. The officers of the Congress are: President, Dr. Shin-ichi Matsumoto; Vice-President, Dr. Ren Kimura; Secretary-General, Dr. Mitsuharu Goto. University Hospital, Medical Faculty of Kyoto University, Kyoto.

NATIONAL BUREAU OF STANDARDS NEW PUBLICATIONS

Three new publications by the National Bureau of Standards will be of interest to radiologists.

Handbook 54, Protection Against Radiations from Radium, Cobalt-60, and Cesium-137, a booklet of 60 pages, presents a revision of the radium protection code made necessary by the increased applications of radium sources and the change in the maximum permissible dose, as well as protective measures against cobalt-60 and cesium-137. The general principles outlined for these sources will also be applicable to other gamma emitters as they become available and attenuation data are obtained for them. While no specific references are made to industrial applications, since these are to be treated in a separate code, the basic principles and the attenuation data of this *Handbook* are applicable to both medical and industrial uses.

Handbook 58, Radioactive-Waste Disposal in the Ocean, 31 pages, is concerned with the many different factors that should be taken into account when radioactive wastes are to be dumped into the ocean, and presents recommendations for the proper use of this disposal method, which appears to be appropriate for intermediate and large amounts of isotopes having long half-lives (more than one year) or high radiotoxicity.

Handbook 59, Permissible Dose from External Sources of Ionizing Radiation, 79 pages, contains the recommendations and discussions of permissible dose which form the basis of all other recommendations of the National Committee on Radiation Protection, including permissible doses for radioactive material within the body, safe handling of radioactive materials, waste disposal, etc.

This *Handbook* presents discussions of the basic concepts of permissible dose and of each of the many factors considered in the formulation of the recommendations. For easy reference the limits of exposure of various parts of the body to various types of ionizing radiation are briefly stated in a section on "Protection Rules."

These three Handbooks are available from the Government Printing Office, Washington 25, D. C. The price for *Handbook 54* is 25 cents, for *Handbook 58*, 20 cents, and for *Handbook 59*, 30 cents. Foreign remittances must be in U. S. exchange and should include an additional one-third of the publication price to cover mailing costs.

M. D. ANDERSON HOSPITAL UNIVERSITY OF TEXAS

Dedication ceremonies for the new $10,000,000 building of The University of Texas M. D. Anderson Hospital and Tumor Institute in the Texas Medical Center, Houston, Texas, were held on Oct. 23. The ceremonies were preceded by a three-day program on cancer diagnosis and treatment.

ERRATUM

Through an unfortunate error, there appeared in RADIOLOGY for August 1954 (p. 258) an uncorrected transcript of a Discussion by Dr. Wm. G. Myers, of the paper by Root, Tyor, Andrews, and Kniseley on "Distribution of Colloidal Radioactive Chromic Phosphate after Intracavitary Administration." The corrected Discussion is printed in full here.

Wm. G. Myers, M.D. (Columbus, Ohio): In view of the findings of many workers of the toxicity of various ions of chromium, I am wondering whether the authors have determined the bleeding times of their patients. Mancuso (Occupational Cancer and Other Health Hazards in a Chromate Plant: A Medical Appraisal. II. Clinical and Toxicological Aspects. Indust. Med. **20:** 393–407, 1951) found the bleeding times to be almost doubled and observed the formation of very soft clots in a large fraction of the workers in a plant in which chromium ores were processed. His work showed that there was a significant concentration of chromium in the blood and urine of these workers which persisted for months after cessation of the exposure to chromium-bearing materials. Perhaps the prolonged bleeding times and the formation of soft clots may have been due to the effect on fibrinogen formation in the liver because of the chronic low-grade toxicity of the chromium.

The other question I would like to ask, in view of the well known toxicity of the chromium ion, is whether the authors have tried to use any of the phosphates of the physiological group of cations. I am thinking particularly of calcium phosphates or iron phosphates because they are also quite insoluble and it should therefore be possible to form colloids of them. Obviously, the use of colloids containing the physiological cations of calcium or iron to carry radioactive phosphorus in the phosphate anion would eliminate the use of the unphysiological chromium cation. Not only is chromium known to be toxic, at least in some of its forms, but it also appears that it may be rather highly carcinogenic as well, particularly when it is deposited in relatively insoluble forms (Mancuso and Hueper: Occupational Cancer and Other Health Hazards in a Chromate Plant: A Medical Appraisal. I. Lung Cancers in Chromate Workers. Indust. Med. **20:** 358–363, 1951).

Books Received

CLINICAL ROENTGENOLOGY. VOLUME II. THE HEAD, NECK AND SPINAL COLUMN. By Alfred A. DE LORIMIER, M.D., Radiologist, Saint Francis Memorial Hospital, San Francisco, Calif.; Consultant in Radiology for the U. S. Army at the Letterman Army Hospital; Consultant in Radiation Therapy for the U. S. Public Health Service

at the U. S. Marine Hospital, San Francisco, Calif.; formerly, Commandant, the Army School of Roentgenology; HENRY G. MOEHRING, M.D., Radiologist, Duluth Clinic, Duluth, Minn.; formerly Director, the Army School of Roentgenology; and JOHN R. HANNAN, M.D., Radiologist, Lake County Memorial Hospital, Painesville, Ohio; Radiologist, Cleveland, Ohio; formerly, Director, Medical Training, the Army School of Roentgenology; Associate Professor, Diagnostic Roentgenology, Frank E. Bunts Educational Institute, Cleveland Clinic Foundation; Staff, Department of Roentgenology, Cleveland Clinic Foundation. A volume of 486 pages, with 734 illustrations. Published by Charles C Thomas, Springfield, Ill., 1954. Price $18.50.

SIXTEENTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, July 1954. A booklet of 138 pages. United States Government Printing Office, Washington, D. C.

ROENTGEN-DIAGNOSTICS. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, AND E. UEHLINGER. First American Edition (based on the Fifth German Edition). English translation arranged and edited by JAMES T. CASE, M.D., D.M.R.E. (Camb.), Professor of Radiology Emeritus, Northwestern University Medical School, Chicago; Consultant in Radiology to the U. S. Marine and Passavant Memorial Hospitals, Chicago; Director, Memorial Cancer Foundation of Santa Barbara; Radiologist (Therapy), Santa Barbara Cottage Hospital, Santa Barbara, Calif. Volume IV. Gastrointestinal Tract. Gynecology, Urology. A volume of 931 pages, with 1,016 figures, accompanied by a Cumulative Index containing 103 pages. Published by Grune & Stratton, New York. Price for Volume IV, $50.00; for Index, $10.00.

RADIOLOGY FOR MEDICAL STUDENTS. By FRED JENNER HODGES, M.D., Professor and Chairman, Department of Radiology, University of Michigan; ISADORE LAMPE, M.D., Professor, Department of Radiology, University of Michigan; and JOHN FLOYD HOLT, M.D., Professor, Department of Radiology, University of Michigan. A volume of 440 pages, with numerous roentgenograms and photographs. Published by Year Book Publishers, Inc., Chicago, Ill. Second Edition, 1954. Price $8.00.

Book Reviews

CANCER OF THE LUNG (ENDEMIOLOGY). A SYMPOSIUM, edited by Dr. JOHS. CLEMMESEN, reprinted from Acta Unionis Internationalis contra Cancrum. Published by the Council for International Organizations of Medical Sciences, Paris, 1954. Price $6.00.

This volume is made up of papers delivered at a Symposium on the endemiology of cancer of the lung held under the auspices of the International Organizations of Medical Sciences, in Louvain, Belgium, in July 1952. It opens with a brief account of the organization of the symposium and the recommendations growing out of it. General discussions on such subjects as the geographic distribution of the pulmonary cancer and its etiological implications, the evaluation of occupational factors, and the relation of tobacco to the disease, are followed by statistical accounts of its occurrence in the United States, Belgium, France, the Netherlands, Norway, and Denmark.

This is an interesting international study of pulmonary cancer and should appeal to all students and workers in oncology. With two exceptions, the papers are in English, with summaries in other languages.

PHYSICAL ASPECTS OF BETATRON THERAPY. By JOHN S. LAUGHLIN, Associate Professor of Biophysics, Cornell University Medical College, Sloan-Kettering Division and Department of Physics, Memorial Center for Cancer and Allied Diseases, New York City; Formerly Associate Professor of Radiology, University of Illinois College of Medicine, Chicago. A monograph of 98 pages, with 34 illustrations and graphs and 11 tables. Published by Charles C Thomas, Springfield, Ill., 1954. Price $3.75.

The first betatron was completed in 1940, operating at 2.5 mev. In the intervening years higher energies have been achieved and operation has become reliable and steady. In a slim volume of less than a hundred pages, Laughlin outlines the physical aspects of betatron therapy. The book is divided into two sections dealing, respectively, with treatment by high-energy x-rays and by the electron beam. The first section includes a discussion of problems of shielding, collimation, and filtration; a chapter on treatment planning, including multiple fields, integral dose, and rotation therapy; and a consideration of dosimetry. The relative biological efficiency of betatron x-rays and 200-kv. x-rays is covered briefly. The second section of the book, on electron beam therapy, follows a similar plan. Much information is presented in the form of graphs and charts, and a long bibliography is furnished.

This book has of necessity a limited appeal, but those working with the betatron or concerned with problems of betatron therapy will find it of interest.

DIE NAHBESTRAHLUNG. By HENRI CHAOUL, Früher o.ö. Professor für Röntgenologie an der Universität Berlin, and FELIX WACHSMANN,

Dozent für medizinische Physik an der Universität Erlangen. Second completely revised edition. A volume of 226 pages, with 304 illustrations. Published by Georg Thieme, Stuttgart. 1953. Agents for U.S.A., Intercontinental Medical Book Corporation, New York. Price DM 39.

Thirty years ago radium therapy became more popular than roentgen therapy under claims of superior biologic effect, greater simplicity of application, and more uniform results. After much study, the authors of this book concluded that there is no biologic superiority of radium over x-rays, that the better results of radium are due to fractionation, protraction, and higher local dosage, and that x-ray therapy could be brought up to an equality with radium by approaching the latter in these respects. With this in mind the use of soft x-radiation at very short distances was introduced in 1931.

The term "contact therapy" originates in the short target-skin distance, which imitates the sharp fall-off in depth dose that occurs in contact radium therapy. Because of the small size of an x-ray target as compared with a radium preparation, and because of the factor of absorption with soft radiation, true "contact" is not feasible. A term such as "near" or "short distance" would be better.

Whether radiation or surgery is used, tumor therapy, to be curative, must be on a local basis. Concerning radiation, it is now known that the tumor must be more sensitive than normal tissue, that a high dose of radiation is necessary, and that the surrounding normal cells must be spared so far as possible. Contact therapy with its low depth doses does spare the deeper tissue, and because of the low integral dose, general reactions do not occur. Moreover, with proper fractionation the recovery rate of the tissue is high and a tremendous tumor dose is permissible. This same soft quality allows one to limit the rays to the lesion with a lead shield, a protection which one cannot obtain with the hard gamma rays of radium. Thus the rule in contact therapy is to irradiate the tumor until it is completely and irrevocably destroyed.

On these principles, the theory and practical application of contact therapy are presented in detail. While the emphasis obviously is on superficial cancer, intracavitary technics are not neglected. A recommendation for the freer use of radiation in surgically exposed neoplasms is made. The specific procedures for both malignant and benign lesions in terms of dose, choice of unit, and fractionation are precisely stated. This directness of statement should be of immense value to the practicing radiologist.

STRAHLENSCHUTZ UND SONSTIGER ARBEITSSCHUTZ BEI DER MEDIZINISCHEN ANWENDUNG VON RÖNTGENSTRAHLEN. Die neuesten Unfallverhütungsvorschriften mit Erläuterungen. By Dr. WILHELM ERNST, Leitender technischer Aufsichtsbeamter und Röntgensachverständiger der Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege, Hamburg. A monograph of 97 pages, with 22 illustrations. Published by Georg Thieme, Stuttgart, 1953. Agents for U.S.A., Intercontinental Medical Book Corporation, New York, N. Y. Price DM 7.80.

On May 12, 1953, the German Ministry of Labor (West Germany) published rules and regulations pertaining to all forms of radiation protection and prevention of health hazards to exposed personnel. In this monograph most of these rules and regulations are reprinted, having been grouped in topical paragraphs, together with the author's helpful interpretation and suggestions. There is a brief discussion of the inherent protection of various units and it is advised that a daily diary be kept, with notations of all exposures received by a patient. Under general considerations the preventive measures that can be taken to minimize exposure to radiation are described, and so-called "active protection" by means of medication, *e.g.* vitamins, is mentioned.

The maximum permissible cumulative exposure of personnel is given as 0.5 r a week. When for specific procedures a protective apron is used, the skin under the apron should receive no more than 0.2 r a week and the unprotected areas 1.0 r a week, which would average about 0.5 r for the entire body. Hands and feet can receive up to 1.5 r a week. The responsible personnel should be familiar with all published rules and their application.

In discussing the prevention of injuries, the author enumerates a number of regulations and suggestions as regards periodic health checks. In addition, special hygienic measures should be instituted: all rooms should be properly ventilated; the floors of the darkroom should be kept dry; the walls of the fluoroscopic rooms should be painted in light colors, etc. Time scheduled in the darkroom should not exceed five and a half hours a day, or 350 hours in four months. Personnel should not be subject to actual roentgen exposure for longer than 900 minutes a week, and when high intensity currents are used, this should be cut to 90 minutes a week. In therapeutic installations, this time can be longer, depending upon conditions. Adequate protective clothing is obligatory, and the problem of various protective barriers is discussed at length. There is a detailed description of the principles which should guide personnel during fluoroscopy, and of rules pertaining to radiographic work.

The author discusses radiation therapy and various protective requirements, the prevention of electric shock, and the problem of storage of inflammable film (used during the war and the first few years after the war). One paragraph is devoted to an appraisal of various monitoring devices. Two appendixes deal, respectively, with specifications for roentgen installations and protective equipment.

Although this booklet is of primary value to Ger-

man specialists, it may, because of its comprehensive treatment, be of some interest also to those who are concerned with radiation protection and prevention of health hazards in other countries.

LA PRATIQUE DU RADIODIAGNOSTIC CLINIQUE. POSITIONS ET TECHNIQUES. By P. BUFFARD. Chargé de Cours à la Faculté de Médecine, Radiologiste des Hôpitaux de Lyon, et L. CROZET, Radiologiste de l'Hôpital de Vienne. Avec la collaboration de M. GOYON. Préface du Doyen HENRI HERMANN. A monograph of 246 pages, with 221 illustrations. Published by G. Doin & Cie, Paris, 1953. Price 2,900 fr.

The primary emphasis in this work is on the practical aspects of radiology. Introductory considerations of technic, choice of factors, darkroom procedures, etc., are followed by a detailed account of radiography of the skeletal system. The various positions are demonstrated by models, but unfortunately the roentgenograms obtained are not reproduced. The positions are for the most part standard, but some are included which are not widely used in radiologic practice in this country, though they might well be retained to enhance our technical armamentarium.

In the opinion of the reviewer, the second part of this book, dealing with visceral radiography, is of especial interest. This is more than a simple manual on technic, in the narrow sense of positioning, including numerous details as to the preparation of the patient and methods of performing the various examinations. For example, prior to examination of the upper gastrointestinal tract, smoking as well as eating and drinking is forbidden and the patient is urged to stay away from pleasant olfactory stimuli. The important role played by drugs, such as morphine, atropine, amyl nitrite, etc., in the execution of gastrointestinal examinations is noted. The suggestion that a film be obtained after splanchnic infiltration in cases of megacolon, to determine the efficacy of surgery, is not, of course, in accord with the latest concepts of this disease, and technics for insufflation of the colon are inadequately described. However, a comparison of the various procedures with current practice in America will suggest many interesting and useful ideas.

Next are considered the technics, contraindications, and untoward effects of a group of special radiographic examinations: mammography, pneumoperitoneum, pneumoretroperitoneum, pneumomediastinum, arteriography, venography, hysterosalpingography, and neuroradiography, even including Lindblom's discography. A chapter is devoted to emergency radiography, and the reviewer is glad to note that preliminary fluoroscopy is recommended in abdominal emergencies, followed by films in both lateral decubitus and transabdominal positions. The book concludes with discussions of foreign bodies and pediatric radiography.

This is unquestionably a worth-while addition to the literature of diagnostic radiology, and the radiologist who reads French, whether he be a beginner or well established in his specialty, will find in it much of value.

OSTEOSKLEROSE UND KNOCHENMARKFIBROSE. By RUDOLF STODTMEISTER, Dr. med., Dr. phil., apl. Professor für innere Medizin an der Universität Heidelberg, Chefarzt der inneren Abteilung de Städtischen Krankenhauses Pforzheim, and STEFAN SANDKÜHLER, Dr. med., Assistent der Ludolf-Krehl-Klinik (Medizin. Univ.-Klinik), Heidelberg, unter röntgenologischer Mitarbeit von ALBERT LAUR, Dr. med., Assistent der Röntgenabteilung der Ludolf-Krehl-Klinik (Medizin. Univ.-Klinik) Heidelberg. A volume of 136 pages, with 29 figures. Published by Georg Thieme, Stuttgart, 1953. Distributors for U. S. A., Intercontinental Medical Book Corporation, New York, N. Y. Price DM 28.50.

This small book is a storehouse of information concerning certain bone diseases characterized by sclerosis and marrow-fibrosis. It takes up, in order, osteopetrosis, hereditary periosteal hyperostoses, generalized infantile hyperostosis, the toxic osteoscleroses (phosphorus, lead, fluorine, strontium), osteomyelosclerosis, and marrow-fibrosis, considering these entities in their clinical, roentgenologic, and pathologic aspects. A large amount of information has been packed into a relatively small space, and while there is much in the book of little value to the average roentgenologist, it can readily be recommended to him as a useful reference work.

The equal billing of the radiologist as a co-author of the work, which is predominantly clinical, makes for a thorough professional consideration of the roentgenologic aspects of the diseases covered. The excellent printing and illustrations are in line with other volumes from this publishing house

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Joe A. Norton, M.D., 843 Donaghey Bldg., Little Rock. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Oscar Harvey, M.D., 3741 Stocker St., Los Angeles 8. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, George Jacobson, M.D., Box 146, 1200 N. State St., Los Angeles 33.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Herbert R. Berman, M.D., 309 St. Claire Bldg., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Parker Allen, M.D., Children's Hospital, Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James T. Shelden, M.D., Box 1021, Lakeland. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard D. Shapiro, M.D., 541 Lincoln Road, Miami Beach. Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ivan Isaacs, M.D., 1645 San Marco Blvd., Jacksonville 7. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr. M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, H. C. Chang, M.D., 1282 Emma St., Honolulu 13. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 238 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). Secretary-Treasurer, Stephen N. Tager, M.D., 219 Walnut St., Evansville 9, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. M. Cherner, M.D., Hays, Kansas. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Veterans Administration Hospital, Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, J. T. Brierre, M.D., 700 Audubon Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Jack Spencer, M.D., Maine General Hospital, Portland 4. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall and at annual meeting of State Medical Association.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, on third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Wm. B. Seaman, M.D., 510 South Kingshighway, St. Louis 10. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Carye-Belle Henle, M.D., 195 N. 7th St., Newark. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clayton G. Weig, M.D., 135 Linwood Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Alan E. Baum, M.D., Hicksville, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Sidney Rubenfeld, M.D., 477 First Ave., New York 16.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Henry H. Forsyth, Jr., M.D., 40 Meigs St., Rochester 7. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St. Toledo.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, February, April, and June, 6:30 P.M., Fort Hayes, Hotel Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. R. Dickens, M.D., Cincinnati General Hospital, Cincinnati 29. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Fred C. Shipps, M.D., 214 Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., 214 Medical-Dental Bldg., Portland 5, Ore. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Otto H. Grunow, M.D., 650 Fifth Ave., Fort Worth 4, Texas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

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SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 21–22, Houston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, W. Paul Elkin, 515–519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

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CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D., *Assoc. Hon. Secretary-Treasurer*, Guillaume Gill, M.D., *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Ls Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUEBEC. ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC. *Secretary*, Jean-Pierre Jean, M.D., 4039 Tupper St., Westmount, Que. Meets four times a year.

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SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. *Secretary*, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA, A. C. *Headquarters*, Calle del Oro, Num. 15, Mexico 7, D. F. *Secretary General*, Dr. Eugenio Toussaint. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86 Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Cardiovascular System

The Digestive System

The Diaphragm

The Musculoskeletal System

Gynecology and Obstetrics

The Genitourinary System

Miscellaneous

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Angiographic Determination of Tumour Pathology. Ingmar Wickbom. Acta radiol. **40**: 529–546, December 1953.

This article deals with vascular changes occurring in glioblastomas, meningiomas, and metastases as observed in a material of about 500 tumors studied angiographically. Truly pathognomonic changes occur in only the first two types, but it is for these very types that a definitive preoperative pathologic diagnosis is particularly desirable, since this may influence the indications for operation.

Glioblastomas are divided into six groups on the basis of the angiographic findings. The characteristic feature of *Group I* is that the contrast-filled veins are observed in the arterial phase, when only arteries are filled in other parts of the brain. This is due to direct connections (so-called arteriovenous fistulas) between arteries and veins, no intermediate system of capillaries being present. Apart from the fistulas, the tumor usually contains numerous irregularly coursing vessels of varying lumen. Contrast-filled veins indicating arteriovenous fistulas were found in 74 of the 243 glioblastoma cases observed.

In *Group II* (30 cases), irregular tumor vessels similar in appearance to those of Group I are demonstrable, but no contrast-filled veins indicating arteriovenous fistulas are seen in the arterial phase.

The tumors of *Group III* (22 cases) also contain many tumor vessels, but these are shorter and narrower than in the foregoing groups, with irregular lumen and small aneurysmal dilatations.

In *Group IV* (59 cases), only some short, comparatively thin vessels with slightly irregular lumen were seen in the tumor region. Vessels of this appearance are not limited to glioblastomas but occur also with other varieties of glioma and occasionally with metastases.

In 28 cases, constituting *Group V*, the tumor region was less vascular than the surrounding tissues, and in 30 cases, *Group VI*, it was not possible angiographically to demonstrate any conspicuous change in the architecture of the vessels. Thus, the possibility of glioblastoma cannot be excluded, even if the tumor is poor in vessels or has an apparently normal vascular structure. In such cases, angiography can make no important contribution to the pathologic diagnosis.

Meningiomas are usually comparatively rich in vessels. Pathologic vessels were present in about half of the 84 cases observed. Frequently, the newly formed vessels follow a twisted or serpentine course, but the lumen is not as irregular as is characteristic for glioblastoma.

In 24 cases, because of the great abundance of capillaries, the tumor was well filled with the contrast medium, appearing as a homogeneous density with smooth, sharply delimited boundaries. As a rule, this accumulation of contrast material in the tumor remains also in the venous phase. In many cases it may be seen in the arterial phase as well.

In 16 cases, the changes in vascularity were due to newly formed arteries. As a rule, these vessels are narrow and follow a serpentine course. They differ from the newly formed vessels of glioblastomas in that they have a regular lumen and show no local strictures or dilatations. They are often arranged in a broom-like fashion or show a radial formation suggesting a wheel.

In 6 cases, definite evidence of blood supply from widened branches of the external carotid was obtained.

The vessels around a meningioma often show such a typical arrangement that a pathologic diagnosis is possible even if it cannot be demonstrated with certainty that the tumor proper contains newly formed vessels. A bowl-shaped arrangement of arteries around the tumor, in which no definite tumor vessels were present, was observed in 7 of the cases in this series.

Metastatic tumors quite frequently have a pathological vascular supply. Out of the 39 verified metastases in this material, pathologic vascularity could be demonstrated in 19 cases. The vascular changes, however, vary within wide limits. The contrast medium may produce a homogeneous density, and in these cases the vascular architecture alone does not permit differentiation from meningioma. Small irregular vessels may sometimes be seen in an early phase, but these are usually more irregular in arrangement and their lumen is more variable as compared to similar vessels in meningiomas. An intracerebral localization is strongly suggestive of a metastasis. Hemorrhages and degenerative changes may occur also with metastases. If the tumor is highly vascular, one may find changes similar to those described for glioblastoma, as, for instance, a poorly vascular region surrounded by a more or less vascularized zone.

Thirty-five angiograms. G. M. Riley, M.D.
Shreveport, La.

Value of Cerebral Angiography in Intracranial Vascular Anomalies. Giulio Gaist. Ann. radiol. diag. **26**: 442–452, 1953. (In Italian)

Intracranial vascular anomalies in general behave like intracranial expansive lesions, with a tendency toward progression through simple dilatation of the vessels or, eventually, through formation of aneurysmal sacs. Arteriography shows clearly the relationships between the artery and veins, as well as the exact location, character, and distribution of the component vessels. A branch of either the internal or external carotid may be involved, making necessary angiography through the common carotid or, even better, selective injection of these two branches. For demonstration of angiomata of the posterior fossa, arteriography of the vertebral artery is necessary. The projections suggested are anteroposterior and lateral, especially stereoscopically. The sagittal projection should under no conditions be omitted, since an arteriovenous aneurysm may be filled by injection of the contralateral artery. The demonstration of arteriovenous communication is not pathognomonic of a true anomalous arteriovenous aneurysm, since such communications have been found also in cases of glioblastoma multiforme.

Patients with arteriovenous aneurysms may present a clinical picture of epilepsy: there is a history of a succession of focal seizures increasing in frequency and intensity, at times with generalized spread; or the patient may complain of incontrollable headaches, with signs of intracranial hemorrhage. Simple radiographic examination of the skull may be negative or may show bony erosion or small foci of vascular calcification

With the increasing use of cerebral angiography, especially as a routine study in patients with epilepsy or intracranial hemorrhage, more and more of these anomalies are being discovered.

The author uses the following classifications of anomalous intracranial vascular formations: (1) cavernous angioma; (2) racemose angioma, which includes Sturge-Weber's disease; (3) angioblastoma; (4) angioglioma. The racemose malformations differ from the cavernous in the interposition of brain parenchyma between the anomalous vessels.

Roentgenograms of 5 cases are reproduced.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Growth and Structural Pattern of the Skull in the X-Ray Picture. W. Bergerhoff. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 745–760, December 1953. (In German)

This article is highly mathematical and technical in nature and does not lend itself well to abstracting. The observations involve over 22,000 measurements on 3,500 skull films obtained from birth to old age. Sagittal and frontal plane views were chosen for the measurements.

The length of the base of the anterior fossa was found to be constant from the age of three to maturity (60 mm.). The angle formed by the coronal suture, tuberosity of the sella, and lambdoidal suture (67.5°), and that formed by the nasion, tuberosity of the sella, and basion (135°) are constant throughout life. The angles formed by the height (67.5°) and width (112.5°) of the skull during the growing years remain practically constant. These factors do not materially change in spite of considerable variation in size and shape of the calvarium.

The numerous angles and measurements are illustrated by line drawings, and the mathematical relationships are considered and formulated. A series of transparent line drawings was made, and by superimposing these on the x-ray films it was possible to estimate deviations from the normal.

Fourteen illustrations. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Cerebral Cysticercosis: An Aspect of the Diagnosis. P. D. de Villiers. South African M. J. **27:** 1097–1098, Dec. 5, 1953.

This is a brief note calling attention to the fact that in cerebral cysticercosis calcified cysts in the thighs are more commonly demonstrated than in the skull. Even these are a late development, since calcification is a slow process.

Two roentgenograms.

THE CHEST

Variations in the Bronchovascular Patterns of the Left Lower Lobe of Fifty Lungs. Martha Pitel and Edward A. Boyden. J. Thoracic Surg. **26:** 633–653, December 1953.

The authors present the results of their analysis of the bronchovascular patterns of the left lower lobe in 50 lungs. These specimens together with those described by Berg and Boyden in 1949 (Berg, Boyden, and Smith: J. Thoracic Surg. **18:** 216, 1949. Abst. in Radiology **54:** 446, 1950) gave 110 specimens on which to base the incidence of variations in the bronchovascular patterns of the left lower lobe.

A very detailed account of the anatomy of the bronchovascular system of the left lower lobe is given, and points of difference between the left and right lower lobes are brought out. The anatomical variations are described, and their percentages in this series are given. The venous, bronchial, and arterial patterns are discussed in detail by segments, with tables showing the incidence of the various patterns in relation to the total number of specimens studied. The paper is illustrated by many drawings and several color plates showing the bronchovascular pattern of the left lower lobe, with all the branches marked according to the terminology of Boyden.

In their discussion the authors point out anatomical variations of special interest to the surgeon and to the bronchoscopist. RENE G. FORTIER, M.D.
St. Paul, Minn.

The Clinical Significance of Funnel Chest Deformity. T. Wegmann and F. Schaub. Schweiz. med. Wchnschr. **83:** 986–990, Oct. 10, 1953, (In German)

Among 690 healthy students of both sexes a funnel chest deformity was discovered in 138 (2.3 per cent). After eliminating those with possibly unrelated positive heart or lung findings, 108 (84 in males and 24 in females) were extensively investigated.

There was no sex preponderance. Seventy-seven per cent of the patients were of leptosomatic-asthenic build. A small number (*einige*) may have merited the diagnosis of a *forme fruste* of Marfan's syndrome (arachnodactyly). The funnel chest was never present at birth. Four patients had rickets and 1 situs inversus. There was nothing to suggest a familial history.

The radiologic appearance of the heart in the postero-anterior projection was characteristic in 50 per cent of the cases and is discussed in detail. An analysis of heart sounds, electrocardiographic findings, and cardiac output studies is given. In 2 cases an apparent enlargement of the right hilus caused by cardiac displacement to the left led to the erroneous roentgen diagnosis of hilar tuberculosis.

Several theories on the cause of funnel chest formation are discussed in the light of the above findings, but the popular hypothesis attributing the deformity to chronic naso-oro-pharyngeal or laryngeal obstruction (adenoids, hypertrophied tonsils, etc.), producing a relative vacuum in the thorax during each inspiration, is not mentioned. The physical findings relative to the nose and pharynx are not reported.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Radiography in the Diagnosis of Hyaline Membrane. Ian Donald and R. E. Steiner. Lancet **2:** 846–849, Oct. 24, 1953.

The diagnosis of hyaline membrane within the lungs of infants dying in the first few days of life can be made with certainty only postmortem. The association of this membrane with atelectasis is now recognized, and since atelectasis is generally accepted as the most important single cause of death in premature infants, the clinical importance of being able to diagnose hyaline membrane during life is obvious. In 1953, Donald and Lord (Lancet **1:** 9, 1953) and Meschan *et al.* (Radiology **60:** 383, 1953) first drew attention to the radiological changes in infants with hyaline membrane in the lungs.

The authors present 28 cases from Hammersmith Hospital, London, from a study of which it appears that not only may the diagnosis of hyaline membrane be suggested but also three different stages in its development, with distinct radiological patterns, may be identified. (1) First there appears to be a fine miliary mottling throughout the lung fields. (2) This is followed in the progressive lesion by a coarse and more coalescent type of opacity. At this stage the bronchial tree is often clearly demarcated. (3) Finally the shadows become confluent as a result of lobar or lobular consolidation and collapse. Death may ensue as the result of some other lesion, *e.g.*, associated intraventricular hemorrhage, before all three stages are radiologically demonstrable, and unless roentgenograms are taken every few hours, it is likely that the course of events will not be observed.

The authors' 28 patients were all newborn infants with respiratory distress. The cases are divided into five groups as follows: Group I: Significant radiological signs; hyaline membrane found at necropsy (11 cases). Group II: Clinical signs of atelectasis, but no radiological signs; hyaline membrane not found at necropsy (8 cases). Group III: No radiological signs, but hyaline membrane found at necropsy (0 cases). Group IV: Radiological and clinical signs present but child recovered; diagnosis therefore unproved (4 cases). Group V: Radiological signs present, but lesions other than hyaline membrane at necropsy (5 cases). The last group might be called false positives.

Caffey (Pediatric X-Ray Diagnosis, 1945), who described a similar appearance in the lungs of premature infants, claimed that this was a physiological phenomenon, representing small areas of atelectasis which resolved within days or weeks without treatment. He ascribed it to structural immaturity of the alveolar buds. The authors believe these appearances are not physiological, having traced their development in patients in whom hyaline membrane was found at necropsy. Nor is the mottling an attribute of prematurity *per se*, since clear lung fields are often demonstrable in premature infants. If the clinical course is progressive and downhill, the fine mottling becomes coarse and tends to coalesce. If, on the other hand, the condition improves, the initial mottling slowly resolves and ultimately the lung fields become clear. The sequence of miliary mottling, coarse mottling, and lobar consolidation and collapse seems to be found only when hyaline membrane is present. The reverse sequence, of pulmonary collapse and subsequent resolution, the authors have observed in pulmonary infection and in some cases of primary atelectasis.

Twelve roentgenograms.

Radiology of Chronic Bronchitis. George Simon and H.-J. B. Galbraith. Lancet **2**: 850–852, Oct. 24, 1953.

As part of a clinical investigation of a large series of cases of chronic bronchitis, standard postero-anterior chest roentgenograms of each patient were taken in suspended full inspiration. The films of 857 of these patients have been studied with a view to determining whether there are any characteristic radiological features of chronic bronchitis, and whether there is any correlation between the clinical severity of the bronchitis and the presence or absence of any of the radiological signs commonly regarded as indicating emphysema. Each roentgenogram was assessed by a radiologist who knew that the patients were suffering from chronic bronchitis and (when he asked) was informed of their age and blood pressure readings. At the time of the assessment, he had no other clinical information.

One hundred twenty-eight patients (15 per cent) had roentgen changes suggestive of emphysema, the occurrence of such changes being directly related to the degree of dyspnea. Radiological evidence of emphysema was seen in only 26 per cent of the patients who were incapacitated by dyspnea. The criteria used to make a diagnosis of emphysema were a low flat diaphragm, a narrow vertical heart with prominence of the pulmonary artery, an abnormal pulmonary vascular pattern, and evidence of bullae.

In 320 patients (37 per cent) some of the radiological abnormalities associated with emphysema were observed, but the appearances were not thought to be sufficient to justify that diagnosis.

No other appearances which might be characteristic of chronic bronchitis were found, and in 354 cases (41 per cent) there were no abnormalities in the lung fields.

Bronchograms of 90 patients with chronic bronchitis were examined, of which 79 per cent showed some abnormality. The principal abnormalities were excessive variation of the bronchial caliber on respiration, localized beaded bronchial dilatation, bronchial diverticulosis, "peripheral pooling," and poor filling of the smaller bronchi and bronchioles.

The authors conclude that chest roentgenograms are essential in the diagnosis of chronic bronchitis because patients with other serious chest diseases are often seen with symptoms of that condition. Once the clinical diagnosis of chronic bronchitis has been established, the value of chest roentgenography is less certain. This study of single standard chest films shows that, except for occasional minor changes, the only abnormalities demonstrated are those which are commonly regarded as indicating emphysema. Although in chronic bronchitis abnormalities are seen more frequently on bronchograms than on standard roentgenograms, bronchography is of less clinical value. The bronchographic findings do not provide much help toward the understanding of the increased sensitivity of the bronchial tree in chronic bronchitis or of the causes of the disabling dyspnea.

Five roentgenograms; 4 tables.

The Radiological Diagnosis of Obstructive Emphysema Due to Non-Opaque Foreign Bodies. G. F. Boult. J. Canad. A. Radiologists **4**: 80–83, December 1953.

Four cases of obstructive emphysema of the lung in children, due to a non-opaque foreign body, illustrate the salient points in making the correct radiological diagnosis. Foreign bodies should be suspected in a child with an unexplained cough, fever, and wheeze. Fluoroscopy should be performed, and films should be obtained in inspiration and expiration, including a lateral view. Even if the films fail to show an obstructive emphysema, if the symptoms are strongly suggestive bronchoscopy should be performed.

Eight roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

Roentgenographic Spreads of Pulmonary Tuberculosis Occurring During Sanatorium Residence Before the Use of Prolonged Chemotherapy. Roger S. Mitchell. Am. Rev. Tuberc. **68**: 863–873, December 1953.

Since approximately 20 to 40 per cent of all progres-

sions of minimal tuberculosis take place before discharge from the sanatorium, determination of why and how often these spreads occur under the protection of the sanatorium environment is important. Spread of tuberculosis is defined, for the purpose of the present study, as any definite increase in the abnormal shadowing seen on routine stereoscopic chest roentgenograms taken at four- to eight-week intervals during the entire sanatorium stay. This includes spreads at or near the site of previous disease as well as in any previously uninvolved area. The study covers a five-year period, from 1947 to 1951 inclusive, before the routine use of prolonged streptomycin-PAS therapy at Trudeau Sanatorium.

In the group of over 800 patients, the yearly incidence of spreads was 15.2 per cent, and this was not affected by thirty- to one-hundred-and-twenty-day courses of streptomycin or streptomycin-PAS, but when prolonged therapy with the same drugs was started, the incidence fell to 4.6 per cent (in 1952). Spread was no more likely to occur in advanced than in minimal disease and was more common in the fifteen- to twenty-three-year age group than in the twenty-four- to forty-five-year group, particularly in males. Sputum culture was more reliable than sputum smears in predicting spread. Patients under close supervision in the infirmary were less likely to have spreads than those admitted to rest cottages, where supervision of rest was not as strict.

Eight tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

The Diagnosis and Significance of Lymph-Node Tuberculosis Perforating into the Bronchial System. E. J. Fischer. Schweiz. med Wchnschr. **83**: 999–1004, Oct. 17, 1953. (In German)

Although perforation of lymph node tuberculosis into a bronchus was long ago described by Laennec, it has escaped general recognition until recently. Only modern diagnostic procedures have made it possible to isolate this phenomenon from the many other pathological processes which occur simultaneously or successively over a period of years during the course of pulmonary tuberculosis. The author believes that he has found in this process, which lasts only two or three months, a fundamental mechanism which explains pulmonary spread of tuberculosis in a considerable number of cases. Its incidence is higher in primary tuberculosis than in re-infection.

Within three years perforation of a tuberculous lymph node into a bronchus was observed in 12 cases among 28 acutely tuberculous patients. Tomography and bronchography led to the detection of twice as many cases as did bronchoscopy. Bronchograms reveal a cavity filled with contrast material, usually twice as large in diameter as the bronchus with which it communicates. A frequent late sequela is bronchostenosis.

Fifteen roentgenograms; 1 drawing.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Pulmonary Hamartoma. Joseph Stein, Harold G. Jacobson, Maxwell H. Poppel, and Lewis R. Lawrence. Am. J. Roentgenol. **70**: 971–981, December 1953.

"Hamartomas" have been defined as "tumor-like malformations in which occur only abnormal mixing of the normal components of the organ." Pulmonary hamartomas are usually found in the periphery of the lung field just below the pleura, though they may occur anywhere in relation to the bronchial tree and the pleura.

Pulmonary hamartomas often produce no abnormal signs or symptoms. Cough, pain, and dyspnea have been said to be the predominant manifestations. The lesion is frequently first suspected on a routine chest roentgenographic examination. Generally it is spheroid in shape and may be lobulated. It is usually well circumscribed and demarcated, without surrounding infiltrate. Calcification and ossification may be noted within the lesion. One of the most characteristic features seems to be the slowness of growth, with only slight change over a period of years.

In making a differential diagnosis, the following lesions must be considered: (1) peripheral bronchogenic carcinoma, (2) tuberculoma, (3) chronic lung abscess, (4) cysts, (5) infarcts, (6) arteriovenous angiomatosis, and (7) metastatic pulmonary carcinoma. The history, rate of growth, and presence or absence of calcium within the lesion may aid in differentiation. In final analysis, however, thoracotomy and biopsy remain the basic definitive diagnostic procedure. The treatment of choice is excision at time of biopsy.

Three case reports are presented, including the roentgen and pathological findings.

Thirteen roentgenograms; 6 photomicrographs.

CLAUDE D. BAKER, M.D.
Louisville General Hospital

Pulmonary Fibrosis and Terminal Bronchiolar ("Alveolar-Cell") Carcinoma in Scleroderma. Jacob Zatuchni, William N. Campbell, and Chris J. D. Zarafonetis. Cancer **6**: 1147–1158, November 1953.

Three cases of scleroderma are reviewed, each with characteristic skin changes, but each presenting as a problem in lung disease. The clinical signs and symptoms, as well as roentgenograms of the chest, suggested bronchiectasis (fibrosis) demonstrable roentgenographically), tuberculosis, and pneumonitis respectively. Not diagnosed antemortem was primary cancer of the lung in association with the diffuse interstitial fibrosis. In each case the cancer was of the terminal bronchiolar variety. This is believed to be the first report of the association of cancer and scleroderma.

Three roentgenograms; 7 photomicrographs.

RICHARD E. OTTOMAN, M.D.
University of California, Los Angeles

An Epidemiological Study of Rheumatoid Arthritis Associated with Characteristic Chest X-ray Appearances in Coal-Workers. W. E. Miall, Anthony Caplan, A. L. Cochrane, G. S. Kilpatrick, and P. D. Oldham. Brit. M. J. **2**: 1231–1236, Dec. 5, 1953.

The usual progressive massive fibrosis of coal workers' pneumoconiosis differs roentgenographically from the findings in the same disease in coal miners with rheumatoid arthritis. In the latter patients there is a more rapid development of numerous discrete, round opacities which appear in crops scattered diffusely throughout both lungs. These attain a diameter of 1 to 5 cm. in a few months and thereafter show little change. Occasionally they calcify or cavitate. These nodules develop on a background of very early pneumoconiosis, whereas progressive massive fibrosis is a continuation of an advanced pneumoconiosis.

The authors report a study of films of miners and former miners of South Wales. From 896 films pre-

viously classified as showing either progressive massive fibrosis or clinically significant tuberculosis, 20 were chosen showing lesions which it was thought would be associated with rheumatoid arthritis, while 60 were randomly chosen as controls. The patients were then examined for arthritis by a physician who was unaware of the roentgen findings. Over 50 per cent of those with films considered characteristic of arthritis were found to have the disease, while it occurred in only 3 per cent of those with the usual picture of progressive massive fibrosis.

This investigation confirms the observation that a particular type of radiologic appearance of the chest is closely associated with the presence of rheumatoid arthritis. On the evidence available, it is not possible to state whether progressive massive fibrosis predisposes to rheumatoid arthritis or whether the same factors predispose to both conditions. After considering various theories, the authors suggest that there may be a particular type of tissue reaction to dust and tuberculosis in the lungs of miners predisposed to the development of rheumatoid arthritis.

Eight roentgenograms; 5 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Pulmonary Hilar Enlargement Associated with Weber-Christian Disease. Report of a Case. Milton Dorfman. Arch. Dermat. & Syph. **68**: 693–698, December 1953.

A case of nodular non-suppurative panniculitis (Weber-Christian disease) is presented. Roentgenograms in this case showed bilateral pulmonary hilar enlargement, with subsequent remission, a finding which has not been described in the approximately 55 cases previously reported.

Relapsing febrile nodular non-suppurative panniculitis is characterized by recurrent episodes of fever, the temperature ranging as high as 104° F., associated with the appearance of single to multiple crops of subcutaneous nodules, varying from the size of a pea to several inches in diameter, usually occurring on the thighs and arms and frequently on the abdomen, back, and legs. The nodules, tender or painless, are freely movable and are located in the panniculus adiposus. They are frequently erythematous and raised above the surface of the normal skin. The nodules do not produce pus and may regress in a few days or weeks, either leaving a shallow dimple in the skin or showing no superficial evidence of their site.

There is no direct pathological proof that the x-ray findings in the author's patient are a part of the disease process. In several cases coming to autopsy, however, there was evidence that the disease may involve not only the subcutaneous fat, but the visceral fat as well. The author feels that in his case the involvement of the intrathoracic fat tissue, probably in each lung hilus, produced the lobular enlargement seen on the chest roentgenogram. Remission of these enlargements is part of the natural history of the disease, producing eventually a normal chest picture.

Three roentgenograms.

Pulmonary Histoplasmosis. A Problem for the Armed Services and Civil Departments of Health. W. A. Jones. J. Canad. A. Radiologists **4**: 70–79, December 1953.

The author describes the various forms of pulmonary histoplasmosis as observed in service personnel during World War II and the Korean War and in university students, nurses, and hospital patients, in the Kingston (Ontario) region. There are five types recognizable radiologically: (1) virulent; (2) pneumonic; (3) disseminated (probably the commonest type in the area studied); (4) nodular; (5) solitary nodule. The disease is rarely fatal, but the differential diagnosis may be confusing. In the acute phase and even in the chronic form histoplasmosis may be confused with active pulmonary tuberculosis. The solitary nodular form may resemble bronchogenic cancer. The multiple nodular form may suggest secondary carcinoma.

In the fatal virulent cases the disease is widespread throughout the recticulo-endothelial system. In the non-fatal acute form it may be widely disseminated through the lungs, with fever and illness of several weeks or months duration. Commonly there is calcification throughout the lung fields, picked up on routine x-ray examination of the chest. A characteristic x-ray finding is calcification with a surrounding halo.

The histoplasmin skin test is helpful, especially when the tuberculin test is negative. In acute cases the organism (*Histoplasma capsulatum*) may be found in the sputum by smear or culture. Cases illustrative of the various types of pulmonary histoplasmosis are presented, with 21 roentgenograms.

PAUL MASSIK, M.D.
Quincy, Mass.

Psittacosis. Two Further Human Cases. A. P. C. Bacon. Lancet **2**: 376–378, Aug. 22, 1953.

Two cases of psittacosis, in a husband and wife, are reported. These cases followed the purchase of a sick budgerigar. The bird subsequently died, and the virus was isolated from its body. The husband was admitted to the hospital in a semistuporous condition, with a week's history of shivering, backache, occipital headache, and dry cough. His temperature was 104° F. A roentgenogram of the chest showed signs of consolidation in the left lower lobe. Penicillin produced no improvement, and consolidation in the right base developed. Chloramphenicol therapy was then started, and the response was prompt. Two months after admission to the hospital, x-ray examination showed resolution in all zones, and about three weeks later the lung fields were virtually clear. The wife suffered from a milder type of psittacosis, which in other circumstances might have gone unrecognized.

Four roentgenograms.

Bronchial Cyst Associated with Anomalous Artery. Wesley Fry, Homer S. Arnold, and Edward W. Miller. Ann. Surg. **138**: 892–898, December 1953.

The authors present a case of bronchial cyst, or sequestrated lung, which they state is the twelfth on record in which the source of blood supply was found to be an abnormal artery arising below the diaphragm. The artery had a diameter of 4 mm., and arose from the left side of the abdominal aorta.

Bronchial cysts have been reported as sequestrated lung, congenital bronchiectasis, or lower accessory lung. In all instances the cystic areas have been non-functioning and detached from the normal lung by a developmental defect or as the result of disease. The sequestra may be within the lung (intralobar), outside the lung and covered with pleura, in the mediastinum, or in the abdomen (abdominal lung). They are almost invariably found below the middle of the thorax.

The authors discuss the possible mechanisms by which these cysts arise. They reject the theory of origin from separate endodermal anlagen, according to which branches of the dorsal aorta "capture" buds from the developing lung and by traction ischemia produce sequestration. Rather they prefer the concept of origin of the abnormal structures from a source distinct from that of origin of the normal lung, probably the caudal part of the anlage of the trachea.

Four roentgenograms; 1 photograph; 2 photomicrographs; 1 diagram. ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Iodized Oil-Sulfonamide Powder Mixture as a Bronchographic Contrast Material. K. Reinhardt. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 699–704, December 1953. (In German)

Oil-soluble contrast media frequently leave a residue in the finer bronchioles and occasionally in the alveoli, causing irreversible damage. At room temperature, Lipiodol is quite viscid, but at body temperature the viscosity is reduced and the medium may permeate the finer bronchial branches and small amounts may enter the alveoli. The author has sought a medium of high viscosity to avoid these untoward effects.

Twenty cubic centimeters of Lipiodol were mixed with 8 gm. of sulfonamide powder and warmed to body temperature in a water bath. This mixture was found to be no more irritating than Lipiodol alone and to require no greater degree of anesthesia. The medium fills the finer divisions of the bronchi but does not enter the bronchioles and alveoli. It furnishes excellent contrast and is coughed up rapidly and completely after the anesthesia has worn off. Usually it has entirely disappeared within twenty-four hours. In none of the author's cases was there any demonstrable residue beyond the sixth day.

The viscosity may be varied. If the larger bronchial divisions are to be studied, 10 or 12 gm. of the powder may be mixed with 20 c.c. of Lipiodol. If the finer divisions are to be investigated, 6 gm. may be used.

Seven illustrations show excellent contrast and adequate filling of all the bronchial divisions.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Apnoea for Bronchography in Children. Margaret E. Browne, K. W. Lovel, Colette Raulin, and Janet P. Rickard. Lancet **2:** 269–271, Aug. 8, 1953.

A technic of bronchography under general anesthesia, using sodium thiopentone and gallamine triethiodide to produce apnea, is described. The procedure has been employed in over 200 cases, with no deaths or serious complications. Better bronchograms have been obtained than with other methods of general anesthesia. There is no risk of explosion, and the apnea produces a completely quiescent bronchial tree, the filling of which depends only on the posture of the patient and on the amount and physical properties of the radiopaque medium. Oxygen can be given at any time with an assured airway, and aspiration of secretions and contrast material is possible. Both sides of the bronchial tree can be examined at the same session. This technic should not be used in young fat children because of difficulty in finding a suitable vein for injection, and children known to be asthmatic should be treated with particular caution.

Four drawings.

Thymus Problem. J. T. Littleton, D. S. Motsay, and S. P. Perry. Am. J. Dis. Child. **86:** 705–716, December 1953.

Five theories have been proposed to explain the causation of symptoms and death by the thymus: (1) mechanical pressure on the trachea, blood vessels, and nerves; (2) status thymicolymphaticus, in which death is due to a constitutional defect associated with thymic hyperplasia; (3) anaphylaxis; (4) lymphotoxemia, with death from excessive and abnormal thymic secretion; (5) hypersusceptibility to a physical and chemical agent. There is little concrete evidence to support any of these theories, and irradiation to reduce the bulk of the gland or to prevent status lymphaticus is thus without rational basis. Nevertheless, many children with stridor, cough, and cyanosis for which a thymic origin is assumed are notably benefited by radiotherapy. This the authors attribute to the effect of the treatment upon an underlying low-grade, chronic, or recurrent tracheobronchitis which is the actual cause of the symptoms.

A physician confronted with a child suffering from stridor, cough, and cyanosis is advised to do a complete clinical study including fluoroscopy, postero-anterior roentgenograms, and films on inspiration and expiration if a foreign body be suspected. Blood studies, including sedimentation rate determinations, throat cultures, an ear, nose, and throat survey, and allergy tests may be necessary. If none of these provide an answer, symptomatic radiation therapy is indicated, but not with any thought of effect upon the thymus itself.

Fourteen roentgenograms. D. DeF. BAUER, M.D.
Coos Bay, Ore.

Ectopia of Primary Thymic Tumors. James H. Forsee, Charles J. Farinacci, and Hu A. Blake. Ann. Surg. **138:** 922-924, December 1953.

The wide bounds within which ectopia of primary thymic tumors may occur are pointed out by the authors. They report 3 cases studied at Fitzsimons Army Hospital during a seven-year period. Two of the tumors arose in the posterior superior mediastinum; the third within the upper lobe of the right lung. During the same interval, primary thymic tumors were found in 17 other patients in the conventional location.

Two roentgenograms; 1 photomicrograph; 1 photograph. ARTHUR S. TUCKER, M.D.
Cleveland Clinic

THE CARDIOVASCULAR SYSTEM

Evaluation of Routine Serial Fluoroscopic Examinations of the Heart in the Postero-anterior and Oblique Views at Specific Degrees of Rotation, with Special Reference to the Angle of Clearance of the Left Ventricle. May G. Wilson, Nathan Epstein, Helen N. Helper, and Katharine Hain. Circulation **8:** 879–882, December 1953.

The authors have analyzed 2,973 serial fluoroscopic examinations performed at specific degrees of rotation in 500 subjects ranging from two to fourteen years of age, presenting no evidence of organic heart disease, and 1,393 similar examinations of 100 rheumatic patients four to forty-eight years of age. In 90 per cent of normal subjects, in the left anterior oblique position the angle of clearance of the left ventricle (clearing the edge of the vertebral column) was less than 55°, while in the abnormal group the angle ranged from 55° to 70°.

It is concluded that fluoroscopic examiaation in the

posterior-anterior and oblique views at specific degrees of rotation is a reliable procedure for detecting cardiac chamber abnormality, and should be included as part of the routine physical examination.

Nine drawings; 2 tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Primary Cardiac Tumors in Infancy. Luther A. Longino and Irving A. Meeker, Jr. J. Pediat. **43**: 724–731, December 1953.

The types of primary cardiac tumors most commonly found during early life, and their diagnosis and management, are the subject of this report.

Of all the primary cardiac tumors that have been described, rhabdomyoma appears to be the only one which shows a definite predilection for the younger age groups; particularly is this true in cases of children suffering with tuberous sclerosis. Such tumors are not considered true neoplasms but probably represent an area of developmental arrest in the fetal myocardium. It is not unusual for rhabdomyoma to regress spontaneously without causing any appreciable impairment of cardiac function.

By far the most frequent primary tumor of the heart is the myxoma, which accounts for slightly more than half of all primary cardiac neoplasms. It may be encountered at any age from early infancy to late adult life. The vast majority of such myxomas are located in the atria, more frequently in the left atrium. They tend to proliferate and project into the chambers of the heart, thus preventing normal cardiac filling, and on occasion obstructing the mitral or tricuspid valve orifices. These tumors probably arise in the auricular septum.

Primary sarcomas of the heart occur at all ages from infancy to adult life. Unlike myxomas, they do not, as a rule, proliferate in an intracardiac direction, but instead infiltrate the wall of the myocardium and extend outward into the pericardial cavity, frequently involving the pericardium.

Other primary cardiac tumors that may occur, but are extremely rare, are angioma, fibroma, lipoma, and hamartoma.

A case is reported of a three-months-old white boy who had a primary rhabdomyosarcoma of the right ventricle. The infant appeared to be normal until after the second month of life, when he began to vomit, failed to gain weight, exhibited anorexia, and refused more than one or two ounces at each feeding. He had repeated episodes of severe coughing and became markedly cyanotic. A roentgen examination showed the esophagus and trachea to be displaced to the right, suggestive of a pericardial effusion.

An exploratory thoracotomy revealed a tremendously distended pericardium. On opening the pericardium, a large mass of myxomatous, viscid, grape-like clumps of tissue herniated through the defect. As much of the tumor as possible was removed, and frozen sections revealed it to be a highly malignant neoplasm. Sixteen days after operation an angiocardiogram was obtained, demonstrating no intracardiac extension of the tumor. Recurrence promptly developed, however, and the child died.

The postmortem examination revealed an extensive tumor that had grown around and encapsulated the major portion of the heart. It had spread widely, involving the left lung, thoracic inlet, and the diaphragm. The pathological diagnosis was rhabdomyosarcoma.

Five roentgenograms; 1 photograph; 2 photomicrographs. HOWARD L. STEINBACH, M.D.
University of California

Single Ventricle with Diminutive Outlet Chamber Associated with Coarctation of the Aorta and Other Cardiac Anomalies. Rene P. Megevand, Raphael N. Paul, and Joseph Parker. J. Pediat. **43**: 687–694, December 1953.

There are three distinct types of single ventricle with diminutive outlet chamber. In all, the mitral and tricuspid valves open into the single ventricle and from it the aorta or pulmonary artery, or both, emerge. The three varieties are as follows: (1) emergence of both great vessels from the diminutive chamber; (2) origin of the pulmonary artery from the diminutive chamber and the aorta from a single ventricle; (3) origin of the pulmonary artery from the common ventricle and the aorta from the primitive chamber.

The course of the circulation is such that the blood from both auricles is emptied into the single ventricle and then flows through the diminutive outlet chamber. The vessel arising from the common ventricle is usually larger than the one emerging from the primitive chamber. This indirectly determines the degree of cyanosis. If the pulmonary artery arises from the single ventricle and thus is of larger caliber than the aorta, cyanosis will be minimal; conversely, if the pulmonary artery arises from the diminutive chamber and is therefore small, the pulmonary circulation will be much reduced and cyanosis will be more intense.

Diagnosis of this malformation is made primarily from the roentgen findings. Since the diminutive outlet chamber is located in the position usually occupied by the pulmonary conus, a "full conus" will be seen in the anteroposterior view. However, in the left anterior oblique position, no such evidence of right ventricular hypertrophy is present, there being little or no anterior projection beyond the border of the aorta. This combination of findings should suggest, therefore, that in the absence of right ventricular hypertrophy the "conus" found in the anteroposterior view is not conus at all, but rather a diminutive outlet chamber.

A case is reported in which a diminutive outlet chamber was associated with an atretic mitral valve, patent foramen ovale, a large pulmonary artery arising from the single ventricle, a small aorta arising from the diminutive chamber, and anomalous pulmonary veins, with the veins from both lungs uniting to form a single trunk which entered the left auricle. The patient also had a coarctation of the aorta just proximal to a patent ductus arteriosus.

Three roentgenograms; 2 photographs; 1 electrocardiogram. HOWARD L. STEINBACH, M.D.
University of California

Herniation of the Left Auricle. Wesley Fry. Am. J. Surg. **86**: 736–738, December 1953.

A case is reported in which a herniation of the auricular appendage of the left atrium through the pericardium presented as an asymptomatic enlargement of the left hilus on a routine chest film. Since the rest of the heart appeared normal at thoracotomy, no attempt was made to replace the hernia. The defect is presumed to be the result of failure of closure of the fetal pleuropericardial membrane.

One roentgenogram; 1 drawing.
RICHARD E. BUENGER, M.D.
Chicago, Ill.

Mitral Stenosis. A Review of 50 Cases Subjected to Operation. David Adler and Denis Fuller. South African M. J. **27**: 1176–1183, Dec. 26, 1953.

The incapacitating symptoms and signs of mitral stenosis—dyspnea, cough, pulmonary edema, hemoptysis, emboli, congestive failure, and occasionally pain and fainting—are indications for valvulotomy. Recent rheumatic activity, subacute bacterial endocarditis, uncontrolled congestive failure, and marked mitral regurgitation are definite contraindications to surgery. Dynamically significant aortic lesions are also contraindications unless the surgeon is prepared to repair both valves at the same operation. Extensive calcification and advancing years are disadvantageous but do not preclude surgery.

Careful clinical examination is essential to establish the diagnosis and to determine the presence or absence of complicating conditions.

The authors report a series of 50 operated cases. Roentgen examination showed an enlarged pulmonary artery in 80 per cent of the cases; enlargement of the left auricle was demonstrated in 92 per cent, and of the right ventricle in 66 per cent. Systolic expansion of the left auricle is mentioned as not indicating significant mitral regurgitation in the authors' experience. Catheterization is undertaken only when the diagnosis is in doubt and not as a routine.

The anterior approach was used for the operation with digital fracturing of the valve. At times, when the valve is too tough or too elastic, the valvulotomy knife must be applied instead.

Eighteen of the 50 patients had no postoperative complications, but there were 7 deaths. As with other new procedures, the number of deaths decreased in the later cases in the series. Embolic phenomena, arrhythmias, hemorrhage, and pleural effusion were the main complications. In analyzing the deaths, it was found that auricular fibrillation and age (over forty years) greatly increased the risk.

Seven roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Use of Angiocardiography in the Selection of Patients for Mitral Valvular Surgery. Harry F. Zinsser, Jr., and Julian Johnson. Ann. Int. Med. **39**: 1200–1218, December 1953.

A study of the angiocardiographic findings in 150 patients with mitral valvular disease is presented. Of the 150 patients, 123 were operated on, and of these 17 died—a mortality rate of 14 per cent. The angiocardiographic technic used was based upon that originally described by Robb and Steinberg (Am. J. Roentgenol. **41**: 1, 1939. Abst. in Radiology **34**: 518, 1940).

After correlation of the findings on angiocardiography with the condition of the mitral valve at operation or necropsy, the authors conclude that two angiocardiographic findings are characteristic of mitral stenosis: (1) a sharp outline of the left atrium due to obviously greater opacification of this chamber in comparison with the left ventricle; (2) persistence of this differential opacification for an abnormally long period. In general, it was found that the left ventricle usually appeared large in those angiocardiograms showing the uniform opacification of the left heart chambers characteristic of mitral insufficiency. Conversely, the left ventricle was relatively small in angiocardiograms showing the marked difference in opacification of the left heart chambers which has been considered characteristic of predominant mitral stenosis. However, atrial size alone was of no differential value.

Auscultation can be misleading. It was most reliable in patients with "pure" mitral stenosis having a loud apical diastolic murmur but faint or absent apical systolic murmurs. Sixty of 123 patients who were operated on had these physical findings and proved to have little or no palpable insufficiency. The absence of an apical diastolic murmur does not, however, exclude mitral stenosis. Five patients without auscultatory evidence of mitral stenosis were referred for commissurotomy because of angiocardiographic findings and all 5 had tight mitral valves without significant regurgitation.

Of 88 patients who had prominent apical systolic murmurs, only 16 (18 per cent) were rejected for operation because angiocardiography showed predominant mitral insufficiency. The remaining 72 showed angiocardiographic findings characteristic of mitral stenosis. Nine of these did not come to operation and 6 died. Sixty-three accepted surgery and at operation 57 were considered to have mitral stenosis without significant regurgitation.

The authors propose a concept of "functional" stenosis and consider that the size of the mitral orifice alone is not of paramount significance. In their opinion, it is important to know whether the left atrium can empty effectively, and angiocardiography makes this clear. The concept of functional stenosis casts doubt on the current concept of the surgeon's finger as the final arbiter in the diagnosis of mitral stenosis and insufficiency. Several patients included in this study who had "positive" angiocardiographic evidence for mitral stenosis were considered at surgery to have "adequate" openings with a regurgitant jet. All of these valves were surgically opened an additional amount, and the patients were much improved. Several of the best results occurred in this group.

Twelve roentgenograms; 1 drawing; 1 table.

R. F. LEWIS, M.D.
Cleveland Clinic

Angiocardiographic Demonstration of Pulmonary Stenosis. Gunnar Jönsson, Bror Brodén, and Johan Karnell. Acta radiol. **40**: 547–553, December 1953.

The difficulty, not to say impossibility, of visualizing the outflow tract of the right ventricle and the pulmonary valves by intravenous angiocardiography has been pointed out in numerous articles. The following views are expressed:

1. Angiocardiography after intravenous injection of a contrast medium is a defective method for visualizing the pulmonary conus and valves in cases of pulmonary stenosis.

2. There is a definite need for an angiocardiographic method that will enable an accurate delineation of these areas.

3. Selective angiocardiography is sometimes suggested for this purpose, but some hesitation seems to be felt in its use.

Since 1948 the authors have performed 100 selective angiocardiographies, injecting the contrast medium into the right ventricle, with no serious complications. The most difficult part of the technic is to make the injection so that the catheter will remain in position and not recoil from the ventricle out into the auricle.

In cases of pulmonary stenosis the outflow tract and pulmonary artery form an arch lying almost exactly in

the sagittal plane. Their anatomy is therefore best visualized in true lateral views, which should be supplemented by others taken in the anteroposterior projection and exposed simultaneously. In cases in which for some reason selective visualization is impossible and the contrast medium must be injected into the superior vena cava, lateral views are worthless, since the outflow tract is obscured by opaque medium in the right auricle. The right anterior oblique projection is the only one that will furnish informative films in these cases but, since the central ray passes obliquely through the infundibulum and the pulmonary valves, these areas will be less distinctly visualized. The opaque medium is, furthermore, more diluted. A direct intraventricular injection is always superior.

In order to reduce to a minimum the irritation to the myocardium, 120 c.c. of a 0.25 per cent solution of Ethocaine is injected slowly through the catheter over a period of five or ten minutes, immediately before the injection of the contrast fluid. The position of the catheter is extremely important. It should lie with its tip in the upper part of the pulmonary conus, immediately below the valves. A 70 per cent solution of Umbradil, about 1 c.c. per kilogram of body weight, is used by the authors and is injected with the aid of a pressure apparatus. The catheter should have as wide a diameter as possible. The rate of injection must be fairly low, not more than 15 to 20 c.c. being injected per second. Films must be obtained in rapid succession. Electrocardiograms should be taken during the examination.

Seven angiocardiograms.

G. M. RILEY, M.D.
Shreveport, La.

Death Following Angiocardiography. Report of Two Cases after Administration of Diodrast and Neo-Iopax, Respectively. E. Grey Dimond and Fethi Gonlubol. New England J. Med. **249**: 1029–1031, Dec. 17, 1953.

Two deaths occurred in the performance of approximately 100 angiocardiographic studies at the University of Kansas Medical Center, while more than 300 cardiac catheterizations were accomplished without incident. Both deaths occurred immediately after injection of the contrast medium, 60 c.c. of 70 per cent Diodrast in a forty-three-year-old woman and 27 c.c. of 75 per cent Neo-iopax in a nine-year-old boy. Preliminary skin testing in each instance was negative.

Both deaths were investigated by autopsy. The woman had anomalous drainage of the pulmonary veins of the right lung into the right atrium, a widely patent foramen ovale, chronic stenosis of the mitral valve, and severe right-sided cardiac hypertrophy. In the boy, primary proliferative pulmonary arterial and arteriolar sclerosis was encountered.

One electrocardiogram; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

A Persistent Left Superior Vena Cava Communicating with the Left Atrium and Pulmonary Vein. Per Ödman. Acta radiol. **40**: 554–560, December 1953.

A persistent left superior vena cava may be recognized in conventional roentgenograms as a prominent, well defined paramediastinal bulge below the aortic arch. If the contrast medium is injected intravenously from the left arm, the vessel may be visualized angiographically. It usually opens into the right atrium or the coronary sinus, in which event the normal course of the circulation is not altered to any appreciable extent.

A persistent left superior vena cava may, however, communicate with the pulmonary veins or the left atrium, thus abnormally shunting the arterialized blood into the right side of the heart. Communication with the left atrium usually occurs in association with other cardiac malformations. Alterations in the circulatory dynamics vary rather considerably in anomalies of this type, depending upon concurrent complicating cardiac malformations. For this reason each case is of particular interest. The author's report concerns a persistent left superior vena cava communicating with the left atrium and one pulmonary vein.

The patient was a 14-year-old boy referred for coarctation of the aorta. A roentgenogram of the thorax showed a prominent rounded soft-tissue contour paramediastinally to the left. On thoracic aortography a total stenosis in the descending aorta, about 3 cm. inferior to the origin of the left subclavian artery, was observed. The paramediastinal anomaly was not investigated, as it was regarded at that stage as a relatively irrelevant anomaly.

At operation, consisting of aortic resection plus end-to-end suturing, a vein the size of an index finger was encountered to the left in the mediastinum, anterior to the vagus nerve. This was identified as a persistent left superior vena cava. Since its circulatory conditions and topography could not be clarified, nothing was done pending more detailed cardiologic and angiographic investigation.

Selective angiocardiography was then carried out, with injection of the contrast medium through a catheter into the pulmonary artery. As the medium reached the left atrium *via* the pulmonary veins, filling of the persistent left superior vena cava was observed at the same time. Good opacification was obtained in both the left atrium and the left superior pulmonary vein, as well as in the left superior vena cava. It was therefore impossible to determine definitely the extent to which the recirculating contrast medium proceeded from the left atrium and the left superior pulmonary vein respectively.

Three roentgenograms.

G. M. RILEY, M.D.
Shreveport, La.

Absence of the Inferior Vena Cava. Daniel F. Downing. Pediatrics **12**: 675–680, December 1953.

Two cases of absence of the inferior vena cava are reported. In both patients the blood from the lower part of the body drained *via* a greatly enlarged azygos vein into the superior portion of the right atrium. The presence of this anomalous drainage might have been suspected on the postero-anterior chest films, where a rounded density was seen in the superior mediastinum, projecting to the right at the position of the normal junction of the superior vena cava and right atrium.

The patients were children, aged twelve months and five and a half years. Both had associated vascular anomalies. In both, the hepatic veins entered the right atrium directly, at the normal site of the inferior vena cava orifice. In both, there was also present a persistent left superior vena cava. The latter vessel in one patient emptied into the left atrium, as did the coronary sinus. In one patient, at autopsy, the right superior vena cava was shown to be absent; in the other its presence was demonstrated by angiocardiography.

The child who was autopsied was found to have a tetralogy of Fallot. In addition there were a partial situs inversus viscerum and other visceral anomalies. The capacity of the left ventricle was estimated to be approximately one-fourth that of the right. The second child had evidence of a high interventricular septal defect.

Five roentgenograms; 2 drawings; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Rupture of Aortic Aneurysm into Superior Vena Cava. Donald L. England. Arch. Int. Med. **92**: 897–905, December 1953.

A review of the literature from 1833 to the time at which the present article was prepared disclosed a total of 117 cases of rupture of an aortic aneurysm into the superior vena cava. Symptoms begin with the sudden onset of a moderate to severe superior vena cava obstruction syndrome. The patient appears seriously ill, with a moderately severe edema, venous distention, and cyanosis sharply limited to the head, neck, arms, and upper chest. Peripheral signs of aortic insufficiency are often present, due to rapid dissipation of the arterial blood pressure into the superior vena cava.

A murmur, usually the characteristic continuous machinery type of an arteriovenous shunt, is heard over the aneurysm, and a thrill may be associated with systole. Laboratory findings commonly disclose a positive serologic test for syphilis, a marked elevation of upper extremity venous pressure, and a prolonged circulation time. Oxygen saturation studies by cardiac catheterization or comparison of peripheral blood values provide conclusive evidence. Roentgenographic studies reveal the pulsating shadow of the saccular aneurysm. The clinical course after the rupture has occurred is usually steadily downhill, ending in death.

The pathologic finding is syphilitic aortitis with a saccular aneurysm of varying size and position in the ascending aorta and one or more perforations of different size and location of the aneurysm into the superior vena cava.

A case is reported.

Four roentgenograms; 2 photographs.

HOWARD L. STEINBACH, M.D.
University of California

Aneurysm of the Posterior Communicating Artery. Report of Five Additional Cases. Leo Madow and Bernard J. Alpers. Arch. Neurol. & Psychiat. **70**: 722–732, December 1953.

The authors report 5 new cases of posterior communicating artery aneurysm. In 4 of these positive arteriograms were obtained. In the fifth, aneurysm was found on autopsy.

Clinically, unruptured aneurysm is characterized by unilateral retro-orbital pain and oculomotor nerve paralysis, usually beginning with ptosis of the eyelid and dilatation of the pupil, which is fixed to light and to accommodation, and progressing to paralysis of the other muscles supplied by this nerve. With rupture of the aneurysm, there may be involvement of other cranial nerves, especially the trochlear, the abducens, and the ophthalmic branch of the trigeminal nerve.

If only the oculomotor nerve is involved, it is not possible to differentiate between an internal carotid and a posterior communicating aneurysm, but angiography may help. It is useful in localizing the aneurysm and revealing multiple aneurysms, but has its limitations in not showing partially obliterated sacs.

Three roentgenograms.

SHOZO IBA, M.D.
Huntington Park, Calif.

Pulmonary Arteriovenous Fistula Occurring in Siblings. Report of Two Cases. Frank Glenn, Charles S. Harrison, and Israel Steinberg. Ann. Surg. **138**: 886–891, December 1953.

Two sisters, aged nineteen and twenty-two years, respectively, were found to have relatively small and asymptomatic arteriovenous lung fistulas, proved by angiocardiography. In each instance evidence of a pulmonary lesion had been obtained several years previously on routine chest roentgenograms, and the girls had been under observation for tuberculosis, without definite diagnosis of infection. Following angiocardiographic demonstration of the fistulas, they were successfully removed, in one instance by lobectomy and in the other by segmental resection.

The classical triad in this condition consists of cyanosis, pulmonary osteoarthropathy, and polycythemia. The authors point out that the lesions sometimes progress with alarming rapidity, even to the point of fatality, and have been found to be associated with brain abscesses. They advocate surgical excision as a prophylactic measure.

Four roentgenograms; 1 anatomic model.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Splenoportography in the Cruveilhier-Baumgarten Syndrome. L. Campi and S. Abeatici. Radiol med. (Milan) **39**: 1171–1180, December 1953. (In Italian)

The authors report two cases of the Cruveilhier-Baumgarten syndrome in which splenoportography was performed, and review the clinical and pathological characteristics. They believe that this syndrome can be said to occur only when the following four criteria are met: (1) hyperplastic-congestive splenomegaly, (2) hepatic sclerosis with atrophy, (3) portal hypertension, (4) "congenital" patency of the umbilical vein. Information obtained through splenoportography is very valuable and the procedure is recommended to demonstrate the status of the umbilical vein, the collateral circulation through the paraumbilical channels, and the degree of portal hypertension.

Other instances of patent umbilical vein with mild (or absent) splenomegaly and cirrhotic or markedly congested liver do not conform to the original description of Cruveilhier and Baumgarten and cannot be considered examples of the syndrome which bears their names. In these spurious cases the presence of a dilated umbilical vein is a sign, and stenosis of the hepatic veins or cirrhosis of liver is the predisposing cause, of portal hypertension.

Ten roentgenograms.

R. G. OLIVETTI, M.D.
Newington, Conn.

Demonstration of the Pelvic Veins through Various Channels. S. Petković. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 739–745, December 1953. (In German)

The diagnosis of pelvic phlebitis is the chief indication for pelvic phlebography but other important diagnoses may also be determined, as thrombosis and other inflammatory and neoplastic processes. The contrast material must be concentrated and free from damaging

effects. Joduron (70 per cent) was used by the author, with an average injection of 20 c.c.

The following sites of injection have been used:

(1) Femoral veins. Not recommended except in the rare instance of obstruction of the external or common iliac.

(2) Os pubis (into the spongiosa). This has the advantage that both the right and left sides are demonstrated by a single injection. The plexus of Santorini and its anastomoses (especially obturator vein) are shown, and occasionally the common and external iliacs.

(3) Tuberosity of ischium. Injection must be made on both sides to fully demonstrate the pelvic veins.

(4) Iliac crests (only one side demonstrated at an injection).

(5) Greater trochanter of femur. Some use this site of injection because of the ease of approach.

(6) Vena dorsalis penis profunda. Easy approach under local anesthesia.

(7) Corpora cavernosa. Not recommended because of the pain incident to the injection.

(8) Clitoris. The injection is made above the ureteral opening, 2 mm. beneath the mucosal surface. The perineal and pudendal veins, deep veins of the clitoris, hypogastric and visceral veins are visualized, the medium finally entering the common iliac and presacral veins.

(9) Collum uteri (second uterine segment). Technically difficult but may be used if no fibrosis is present.

(10) Urethral mucosa. Not recommended because of possible emboli.

The author reports 75 cases and recommends for routine use the tuberosity of the ischium in males and the clitoris in females.

In cases of thrombophlebitis, a rather abrupt blocking of the vein and collateral circulation may be demonstrated. An incompletely filled vein is not necessarily indicative of disease, but a narrow lumen with irregular outline is very suggestive. Interference with venous circulation or displacement is present in most tumors. Pelvic carcinoma may not necessarily give definite signs, and the type of tumor cannot be diagnosed in most instances. In the presence of fibrosis from radiation and in cases in which evisceration has been performed, the normal venous pattern is absent. Varicosity is usually associated with similar conditions in the lower extremities and is most frequently found in women. Demonstration of the pelvic veins is of differential value in certain types of prostatic pathology: in adenoma, the veins show an abnormal degree of separation; in malignant conditions there is less separation, the lumen of the individual veins is smaller, and fewer veins are visualized. Pregnancy is indicated by wide spreading of the veins.

Ten roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

The Adnexal Branches of the Uterine Artery. An Arteriographic Study in Human Subjects. U. Borell and I. Fernström. Acta radiol. **40**: 561–582, December 1953.

One hundred and seventy-one cases were examined by pelvic arteriography, and the uterine artery was seen to send a branch to the adnexa in 69. The area of distribution of the adnexal blood vessels presented great variation.

In the majority of the cases, arteriography was carried out by a method devised in the Roentgen Department of Karolinska Sjukhuset and described in an earlier paper (Borell *et al.*: Acta radiol. **38**: 247, 1952. Abst. in Radiology **61**: 458, 1953), three films being taken at intervals of two or three seconds in each case. As a rule, the adnexal branch of the uterine artery did not show up in the first film but was clearly visible in the second and third. The other blood vessels in the true pelvis were then generally no longer opacified.

The width of the uterine artery and its adnexal branch was measured directly from the arteriogram to an accuracy of 0.5 mm. The measurements of the uterine artery were made at the point where it leaves the lateral pelvic wall. The width of the adnexal branch was measured at its point of origin. A drawing of its course was reproduced on tracing paper directly from the films.

The findings in a control group of 18 patients without pelvic abnormality were compared with those in cases of salpingitis, tubal pregnancy, tumor of the ovary, uterine myoma, amenorrhea, and intra-uterine pregnancy. All the patients with amenorrhea were examined both before and after hormone therapy. The changes in the uterine artery were found to be so characteristic in many cases of ovarian tumor and tubal pregnancy that an arteriographic diagnosis could be made. In the patients with amenorrhea, the width of the artery was found to increase after hormone treatment.

In salpingitis the adnexal branch was thought to be slightly wider than in the controls. It followed a slightly straighter course and in the majority of the cases studied showed branching. In tubal pregnancy also, the width of the adnexal branch was increased and the course was less tortuous than in control cases.

In the majority of patients with ovarian tumors an adnexal branch was clearly visible. Its width was markedly increased in cases of fibroma and carcinoma. The course was straight in all but 4 cases of this group. There was no radiographic evidence that visualization of the adnexal branch bore any relation to the size of the tumor.

In myoma a branch was visible in a minority of the cases and in width and course this was practically identical with that in the control group. In the 8 patients with amenorrhea the adnexal branch was seen in 6 before hormone therapy. The width was decreased, but the course was practically the same as in the control group.

In the cases of intra-uterine pregnancy a branch was visible in only 5 out of 35 cases. The width and course were the same as in the control group and there was no evidence of branching.

Sixteen arteriograms; 8 diagrams; 1 table.

G. M. RILEY, M.D.
Shreveport, La.

Post-Traumatic Obstruction of the Veins of the Upper Limb: A Radiologic Contribution. M. Chiaudano and P. C. Monateri. Ann. radiol. diag. **26**: 432–441, 1953. (In Italian)

While the clinical diagnosis of venous obstruction in the upper limb may be difficult, the phlebographic picture is typical, being especially valuable in indicating the site and extent of the obstruction. The authors do not advise using contrast material with an iodine content in excess of 50 per cent, because of the possi-

bility of endothelial injury. The limb is held abducted and horizontal, and the injection is made as far distally as possible. One can usually visualize the venous system as far as the medial third of the clavicle. The examination when conducted during the Valsalva maneuver is especially good for the morphologic details of the veins. With this maneuver, one generally obtains visualization of the subclavicular vein as far as its entrance into the innominate vein. Usually, three roentgenograms suffice: one after the injection of 10 to 15 c.c. of contrast material, while the operator continues to inject (20 c.c. is the maximum dose used by the authors), a second at the end of the injection, and a third after a further interval of twenty seconds to demonstrate possible delay in the emptying of the venous system.

So-called traumatic thrombosis of the superior limb is rare, about 100 cases being described in the literature. The etiology, as well as the pathogenesis, is still obscure in many respects. Usually the patient complains of indirect trauma, as by lifting a weight or even protracted effort. In the former case, there is sudden violent pain with a stinging sensation in the superior third of the arm and in the axilla, followed by a feeling of heaviness in all the limb. When the thrombosis follows a protracted effort, the symptomatology is attenuated, and a sense of heaviness and fatigue predominates. Objectively the arm is swollen, with more or less cyanosis and fullness of the superficial veins, particularly the cephalic. The general state of the patient is good and there is no fever. At times, one is able to feel a hard cord which corresponds to the thrombosed vein. Usually, the subjects are young, and 75 per cent are men, generally with good muscular development. Eighty per cent of the cases involve the right arm.

The authors report in detail two cases of post-traumatic disturbance in the deep veins of the upper limb with adequate x-ray studies. They believe that an actual thrombosis was present in one of the cases, initiated by a direct injury, but in the other case, due to an indirect injury, a neural reflex may well have played a role. No matter how one interprets the pathogenesis of traumatic thrombosis from effort, the importance of the phlebographic examination for the diagnosis of the obstruction, and above all the exact localization, remains fundamental.

Six roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Investigation of Obliterative Arterial Disease of the Lower Limb. David Messent, R. E. Steiner, and John F. Goodwin. Lancet **2**: 1324–1329, Dec. 26, 1953.

The authors have made a comparative study of various procedures used in the determination of the integrity of the peripheral circulation of the lower limb, seeking to assess their value with reference to the diagnosis and treatment of obliterative arterial disease.

Arteriography is the only method permitting an accurate assessment of the presence of early disease, the level and length of the block, the condition of the arterial wall, and the patency of the vessel beyond the block. The collateral blood supply cannot be estimated quantitatively, but a study of the number, caliber, and tortuosity of the vessels is helpful. The skin blood flow may be judged approximately, and a relationship of the origin of muscular vessels to the site of disease is of significance.

The procedure should be reserved for this latter group, for certain cases in which amputation is to be done, and for the confirmation of early organic disease.

Five illustrations, including 1 arteriogram; 4 tables.

THE DIGESTIVE SYSTEM

Limitations in the Use of Roentgen Examination of the Gastrointestinal Tract. Paul C. Swenson and Robert B. Jeffrey. J.A.M.A. **153**: 1422–1424, Dec. 19, 1953.

There are times when a properly conducted and interpreted roentgen examination of the gastrointestinal tract may yield results that are conflicting or fallacious. This may occur when abnormalities are actually present but are undemonstrable by roentgen means. Again, the finding may be non-specific and its interpretation may not be in agreement with the final diagnosis. Still another instance occurs in areas of the gastrointestinal tract where it is difficult to demonstrate abnormalities even when they are known to be present, *e.g.* Meckel's diverticulum.

The demonstration of any lesion of the upper gastrointestinal tract depends on its size, its distortion of the mucosal pattern, production of filling defect, and interference with flexibility. In the colon, however, lesions measuring as little as 2 and 3 mm. can be detected with good double-contrast studies.

The importance of proper preparation of the patient is stressed. Repeat examinations not only involve expense but also increase the amount of radiation received by the radiologist and patient.

Extraluminal masses can be detected only when their size is sufficient to have encroached upon normal structures. By interference with blood supply, lymph drainage, or innervation, lesions in the abdomen may change the intestinal pattern. This, however, is a non-specific finding. Diverticula may be filled with feces or blood clots, or may have so wide a neck that contrast material is not retained, increasing difficulty of diagnosis. Functional changes and emotional and allergic states may produce changes in intestinal pattern.

Diagnosis of esophageal abnormality is made difficult by rapid passage of barium through the esophagus. Varices may not be demonstrated if small or if collapsed from recent hemorrhage. Diagnosis of ulceration or neoplasm within a hiatus hernia is also difficult.

The proximal end of the stomach is most difficult to examine because of its inaccessibility to palpation. One must depend on fluoroscopic appearance of the cardia plus changeability on multiple films. Elsewhere in the stomach it is sometimes difficult to distinguish between a benign ulcer and an ulcerated neoplasm.

In the small bowel a small intramural lesion is easily missed unless obstruction has resulted. The nonspecific finding of a swollen, irregular mucosal pattern with segmentation and sometimes widening of the lumen can be caused by either local intramural changes or mesenteric involvement, in which case either the intramural nervous mechanism or the lymph-vascular and blood supply is affected. The blood supply and lymph-vascular drainage can be affected both by inflammatory change and by neoplasm. The pattern and transit time may be affected further by the following factors: (1) so-called allergic (food sensitivity) changes; (2) tumor, either intramural or mesenteric; (3) intramural inflammatory changes; and (4) extraluminal masses. The findings in the obstructing lesions, which are often

definitive, may sometimes be very difficult to interpret completely.

The authors conclude that, in spite of its limitations, the roentgen examination remains the most important single diagnostic method, short of exploration and biopsy, for study of the gastrointestinal tract.

JOHN P. FOTOPOULOS, M.D.
University of Michigan Hospital

Roentgenologic Considerations of Gastro-Intestinal Bleeding. Robert D. Moreton. J. M. A. Georgia **42:** 523–528, December 1953.

Beginning with the esophagus, the author discusses briefly the various lesions of the alimentary tract which may cause bleeding, reminding the reader that in 10 to 12 per cent of cases the cause cannot be found, even at surgery.

Esophageal lesions which may produce bleeding include varices, carcinoma, and rarely lymphosarcoma. In cases of hernia of the short esophagus type, peptic ulceration at the junction of the esophagus and the stomach may occur.

Proceeding to the stomach, the author lists gastric varices, diaphragmatic hernia, peptic ulcer, benign and malignant neoplasms, and diverticula. Gastric mucosa protruding through the pylorus may also bleed.

In the duodenum, peptic ulcer is the common source of hemorrhage, but rarely carcinoma of the duodenum or ampulla of Vater may be responsible. In the remainder of the small bowel benign and malignant tumors, intussusception, and Meckel's diverticulum must be considered. Benign and malignant lesions of the colon may bleed, as well as diverticula and various forms of colitis.

The role of the roentgenologist is not only to prove or disprove the presence of the lesion suspected by the referring physician, but to recognize the possibility of the many other pathological processes which may produce this symptom, and to rule out or demonstrate them, as the case may be.

Eleven roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Motor Mechanisms of the Esophagus, Particularly of Its Distal Portion. Guillermo C. Sanchez, Philip Kramer, and Franz J. Ingelfinger. Gastroenterology **25:** 321–332, November 1953.

Following a concise historical record, the authors present their own esophageal pressure studies. Pressures produced intraluminally were measured through two No. 10 intravenous catheters simultaneously present in the esophagus with their tips 8 cm. apart. Both "moist" and "dry" recordings were made, the latter in a patient having bulbar poliomyelitis in whom no passage into the esophagus occurred.

In the upper seven-eighths of the esophagus the swallowing complex showed two major components: an immediate slight elevation of pressure of the order of 10 mm. Hg, corresponding to the injection of oral contents into the esophagus, and a later, higher pressure of the order of 100 mm. Hg, produced by peristaltic contraction. During repeated swallowing, the peristaltic wave is inhibited until after the last swallow.

The distal or supradiaphragmatic portion of the esophagus is apparently different both anatomically and neurologically. Pressure falls off in the ampulla, and initial peristaltic pressure is not transmitted into the vestibule.

Activity differences in the lower esophagus may account for the benign clinical disorders affecting this area.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Dysphagia Due to a Diaphragm-Like Localized Narrowing in the Lower Esophagus ("Lower Esophageal Ring"). Richard Schatzki and John E. Gary. Am. J. Roentgenol. **70:** 911–922, December 1953.

The authors present 5 cases in which the chief complaint was intermittent dysphagia, with a roentgen picture characterized by a concentric, smooth diaphragm-like narrowing in the lower esophagus, approximately 5 cm. above the diaphragm. The ring is present constantly and does not change its position, but is visible only when the esophagus above and below is filled enough to produce dilatation to a caliber greater than the diameter of the ring. The thickness of the concentric ring usually measures between 2 and 4 mm. It always constricts the caliber of the lumen to the same diameter in a given patient. A solid bolus of food or a large capsule can stretch the ring slightly, but there is always a return to the original size.

As a solid bolus is pushed through the ring, and to a lesser extent as a liquid stream of barium passes through the ring, it shows a downward bending which produces a characteristic squaring or beaking at the edge of the lumen just below. This phenomenon is not seen below the narrowing produced by the muscles at the upper end of the phrenic ampulla and helps to differentiate the two.

Symptoms in the 5 cases presented were of one to nine years duration, and in 3 cases had become progressively more severe since onset. Only one of the patients lost weight. Some were labeled as neurotics because of absence of weight loss and periods of well-being alternating with episodes of dysphagia.

The authors feel that the differential diagnosis presents no great problem, except for fibrosis of the lower esophagus as produced by a healed ulcer or reflex esophagitis. In the "lower esophageal ring" cases, the ring is always almost symmetrical and the involved segment is very short, whereas in fibrosis the narrowing is usually asymmetrical and longer. The segment does not appear as rigid as in a scarred esophagus and there is no delay in emptying of the esophagus. Endoscopy showed no inflammation, ulcer, or scarring in the 5 patients reported here. Other diseases to be considered, however, are: (1) carcinoma, (2) cardiospasm, and (3) the ring-like structure seen in the lower end of the esophagus in persons that have no difficulty in swallowing. Usually, however, the latter rings are almost without exception of larger diameter than the symptomatic rings and there sometimes is a change in diameter of the asymptomatic ring over a period of months or years. It is not known whether the two types of ring structures are due to similar mechanisms.

The authors supplement their own series of cases by reference to a series of similar cases reported by Ingelfinger and Kramer (Gastroenterology **23:** 419, 1953. Abst. in Radiology **62:** 135, 1954). The latter writers believe that, at least in the milder cases, the ring may become more pronounced following an obstructive episode and may migrate toward the diaphragm. With this view, the authors disagree.

Thirty roentgenograms; 1 chart.

CLAUDE D. BAKER, M.D.
Louisville General Hospital

The Disturbance of Esophageal Motility in Cardiospasm: Studies on Autonomic Stimulation and Autonomic Blockade of the Human Esophagus, Including the Cardia. M. H. Sleisenger, H. Steinberg, and T. P. Almy. Gastroenterology **25**: 333–348, November 1953.

Previous studies based upon stimulation or division of discrete sympathetic or parasympathetic nerves supplying the esophagus have yielded inconsistent results. Since drugs are now available which stimulate or block action of various elements of the autonomic nervous system, experiments were designed (*a*) to confirm the effects of methacholine in cardiospasm and explore their significance; (*b*) to determine the effects of anticholinergic agents; (*c*) to observe the actions of epinephrine and norepinephrine on the normal and diseased esophagus; and (*d*) to study the actions of adrenergic blocking agents upon the cardia and the body of the esophagus.

The action of the drugs upon the cardia was studied fluoroscopically, and spot x-ray films were taken following the ingestion of a standard barium sulfate suspension in both control and test periods. Motility was recorded by a balloon-kymographic technic. Methacholine, acetylcholine, physostigmine, Banthine, *l*-epinephrine, *l*-norepinephrine, dibenzyline, Regitine, and Etamon were all used in the experimental study.

The authors' observations give support to the idea that in cardiospasm the motility of the entire esophagus is impaired for want of integrated parasympathetic stimulation. Sensitivity to the effects of methacholine lend credence to this view. Acetycholine produced esophageal spasm. Banthine reduced or abolished the spontaneous activity of the esophagus. Adrenergic stimulation did not alter esophageal function in normal subjects or patients with cardiospasm. It did reduce phasic activity in the esophagus of cardiospastic patients. Adrenergic blocking agents did not cause relaxation of the cardia.

Eight roentgenograms; 7 tracings; 3 tables.

JOESPH P. TOMSULA, M.D.
Baton Rouge, La.

Pseudodiverticulum of the Esophagus Associated with Cardiospasm. Robert J. Priest and Conrad R. Lam. Gastroenterology **25**: 393–397, November 1953.

This is a case report of the unusual association of a pseudodiverticulum with cardiospasm. Roentgen examination revealed a large pouch involving the upper third of the esophagus. It resembled a pulsion diverticulum. The esophagus showed marked dilatation and hyperperistaltic activity. There was narrowing at the cardia, and only a small amount of barium passed into the stomach.

A cardioplasty of the Wendell type was performed to correct the cardiospasm. Surgery on the upper third of the esophagus showed the pseudodiverticulum, which was excised.

Three roentgenograms.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Insufficiency of Cardia in Hiatus Hernia. Charles A. Flood, Josephine Wells, and Daniel Baker. Gastroenterology **25**: 364–374, November 1953.

Forty-one patients with radiologic evidence of hiatus hernia were studied to ascertain the frequency of esophageal reflux, a phenomenon which has been correlated with the presence or absence of esophagitis. All patients had gastrointestinal symptoms.

The results of this study are in general accord with the observations of others, that esophageal reflux is a common occurrence in individuals suffering from hiatus hernia. In this reported series, the phenomenon was encountered in somewhat more than half of the patients. It seems possible that a relaxation of tone at the cardia may commonly occur with hiatus hernia and permit reflux of fluid into the esophagus if the pressure is lower than in the fundus of the stomach. The incidence of reflux appears to bear no relation to the angle at which the esophagus enters the stomach.

Esophagitis associated with hiatus hernia presents a changing picture, and in at least some individuals ulceration may appear and disappear rapidly. If acid reflux is the important factor in producing such ulceration in association with hiatus hernia, fluctuations in the degree of esophagitis remain to be explained.

Five roentgenograms; 1 chart; 2 tables.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Diagnostic Accuracy in Gastric Ulcer. Frank B. McGlone and D. W. Robertson. Gastroenterology **25**: 603–613, December 1953.

There is no question that at times peptic ulceration of carcinoma may produce a lesion indistinguishable from benign gastric ulcer, but there is considerable controversy over the frequency with which this occurs. This problem has been studied on the basis of 342 case records of patients having benign and malignant gastric ulcers who were followed for an adequate length of time.

There were no single specific clinical signs pathognomonic for either malignant or benign ulcers. The size of the lesion was of little significance (8 lesions more than 4 cm. in diameter were benign and 2 very small ulcers were malignant), as was a history of bleeding.

Most ulcers were found on the lesser curvature and the highest degree of accuracy occurred in the diagnosis of these lesions. The prepyloric lesions caused the greatest confusion, with 9 cases in 101 being misjudged (a percentage error of 8.9). This is in contrast to a percentage error of 2.2 per cent on the lesser curvature, where 4 cases out of 198 were misjudged. One interesting point in the study was the number of greater curvature ulcers which were found on exploration to be benign. Of 16 ulcers in this location, 7 were benign and 9 malignant. Nevertheless, on the basis of location alone, greater curvature ulcers should still be considered malignant until proved otherwise.

The general conclusions of the study are that, if the patients are studied carefully, and if surgery is recommended on the suspicion of malignancy, very few malignant ulcers will be overlooked. Malignancy may be suggested by the radiographic appearance or by gastroscopic studies. Prepyloric ulcerations should be considered malignant unless there is strong clinical evidence of their benign nature (including healing). Greater curvature lesions, as pointed out above, are also to be considered malignant. Failure of a lesion in any portion of the stomach to heal in a reasonable period of time would suggest malignancy.

Three illustrations; 3 tables.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

A Clinical Evaluation of a New Anticholinergic Drug, Pro-Banthine. I. Richard Schwartz, E. Lehman, R. Ostrove, and J. M. Seibel. Gastroenterology **25:** 416–430, November 1953.

This is a preliminary report covering a twelve-month experience with Pro-Banthine in the treatment of peptic ulceration, hyperacidity, functional diarrhea, chronic non-specific ulcerative colitis, regional enteritis, and "dumping syndrome."

Pro-Banthine diminishes the volume of gastric secretion and inhibits gastric motility. It is three to four times as powerful as Banthine and has less annoying side effects. Headache was complained of by more than 10 per cent of patients. Difficulty in urination, as with Banthine, must be given serious consideration in elderly subjects. Other side-effects included dryness of the mouth, blurring vision, constipation, and occasionally urinary frequency.

Relief from ulcer pain is unusually prompt with Pro-Banthine, the average time being forty-eight to seventy-two hours after the beginning of therapy. Of 129 patients with peptic ulceration, 106 were completely relieved of pain. Of 80 patients with ulcer craters radiologically demonstrated, 59 showed complete healing within four weeks. Acute duodenal ulcers healed in from two to four weeks.

Twelve roentgenograms; 2 tables.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Leiomyosarcoma of the Stomach. Review of the Literature and a Report of Seven Cases. Charles L. Poskanzer and Rudolph M. Schmidt. Am. J. Surg. **86:** 696–706, December 1953.

The literature on leiomyosarcoma of the stomach is reviewed and 7 cases are presented. This is a rare gastric tumor with symptoms similar to gastric ulcer or carcinoma. Roentgenologic findings may suggest the diagnosis when an intramural tumor is found displacing the stomach or if the lumen of the stomach communicates into a cavitation within the tumor. If no metastases are found at operation the prognosis is good because growth is slow. Radiation has no place in the treatment of these tumors. Three of the 7 patients were alive two, four, and five years after surgery.

One roentgenogram; 2 photomicrographs; 5 photographs.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Roentgen Study of Gastric Mucosal Relief (Significance of So-called Gastritis granularis). W. Frik and A. Zeidner. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 681–692, December 1953. (In German)

Granular gastritis has recently been described by Bücker (Fortschr. a. d. Geb. d. Röntgenstrahlen **71:** 240, 1949. Abst. in Radiology **54:** 621, 1950). Mahlo, using a high-penetration compression technic (Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 492, 1952. Abst. in Radiology **61:** 679, 1953) reported granular changes in 30 per cent of the cases examined.

The present author reviewed 1,004 cases and observed apparent signs of mucosal irregularity in 349 cases, which he describes as of six types, roentgenographically: (1) a delicate network pattern in individual elongated areas 0.5 to 1.5 mm. diameter; (2) a similar type of pattern in areas between 1.5 and 2.5 mm., usually round or polygonal; (3) more marked granularity, often observed without compression; (4) mottled areas, larger than 3 mm., with gross irregularity of the pattern; (5) a serrated appearance of the greater curvature; (6) actual polypoid formation (5 cases).

An attempt to correlate the x-ray and clinical findings appeared to show a higher percentage of mucosal changes in patients with a history of stomach or gallbladder disease, especially of long duration.

A group of 13 doctors without symptoms were also examined. In 7 of these, areas of mucosal relief were demonstrable. In 1 with a history of past gastrointestinal disturbance the roentgen findings were entirely normal. Six of the group, including 3 with questionable changes, gave a history of acute gastric symptoms at an earlier date.

The author believes that his observations cast doubt upon the existence of a "granular gastritis" as described by Bücker.

Twelve roentgenograms; 5 charts.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Mucosal Hypertrophy of the Stomach. Report of a Case. Fairfield Goodale, Jr., and Ronald C. Sniffen. New England J. Med. **249:** 1105–1107, Dec. 31, 1953.

Mucosal hypertrophy of the stomach is characterized by marked elongation of the normal gastric glands producing a true thickening of the mucosa. X-ray examination shows giant rugae which cannot definitely be differentiated from hypertrophic gastritis, polyposis, or infiltrating neoplasms.

Symptoms of mucosal hypertrophy have varied so much that they may probably be considered functional. Laboratory examination of gastric juice and physical examination are negative. One reported case was associated with hypoproteinemia and was relieved by total gastrectomy; in another an anaplastic carcinoma developed, though there is no evidence that the condition is "precancerous."

A single case is reported. Total gastrectomy was done because a malignant growth could not be ruled out.

One roentgenogram; 1 photomicrograph; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Gastric Diverticula. A. W. Sommer and W. A Goodrich, Jr. J.A.M.A. **153:** 1424–1428, Dec. 19, 1953

The authors found in the literature reports of 449 cases of gastric diverticula. Their report is based on 21 cases seen at the Scott & White Clinic (Temple, Texas). The most frequent symptom is epigastric discomfort, though uncomplicated gastric diverticula are frequently asymptomatic. In only about one-third of the reported cases were there symptoms attributable to the diverticulum. Bleeding is the commonest complication. Erosion, gastritis, and perforation may occur. There may be an associated benign or malignant neoplasm, although there is no evidence that carcinoma is especially prone to develop in a diverticulum.

Most diverticula are discovered roentgenologically. In the authors' series, 20 occurred at the cardiac end of the stomach, arising from the posterior wall 3 to 5 cm. from the esophagogastric junction. Half of the number were from 2 to 3 cm. in diameter. Only 6 of the 21 patients had symptoms attributable to the diverticulum. Pain was present in each of these patients, with radiation to the lower retrosternal region. Bleeding occurred in 3 cases. In 1 patient a diverticulum

was known to have been present for twenty-five years without symptoms.

At least 75 per cent of gastric diverticula arise from the posterior wall of the stomach, 3 to 5 cm. from the entrance of the esophagus. About 15 per cent occur near the pylorus. Diverticula in the cardiac area rarely fill if the patient is examined only in the upright position. Filling is best obtained with the patient recumbent in the posterior oblique position. The appearance of a gastric diverticulum in the cardia, once filled, is quite diagnostic. The characteristic location, smooth rounded outline, and relatively narrow neck make recognition easy. Benign gastric ulcer seldom occurs in this portion of stomach, and its broad base and failure to retain barium are important differential features. Ulcerating carcinoma may show a pouch-like defect near the cardia. This defect is always irregular, and a meniscus sign is frequently present. Following repair of a hiatus hernia a contraction ring of scar tissue may remain to constrict the stomach near the cardia. This may resemble a diverticulum, but it has a broad base, and the esophagus can be seen to enter directly into this pouch.

Diverticula near the pylorus present more of a diagnostic problem. Benign ulcer craters, perforated ulcers with accessory pocket formation, ulcerating carcinoma, and syphilis of the stomach present the most serious differential problems. Diagnosis of a diverticulum near the pylorus should always be surgically confirmed because of the serious consequences of an erroneous diagnosis. Elsewhere than at the cardia or pylorus, diverticula can rarely be definitely diagnosed without surgery or gastroscopy.

Four roentgenograms; 3 tables.

JOHN P. FOTOPOULOS, M.D.
University of Michigan

Radiological Examination in Organic Diseases of Small Intestine. Ross Golden and Pablo L. Morales. J.A.M.A. **153:** 1431–1433, Dec. 19, 1953.

The authors reviewed 168 cases of verified organic small bowel disease in order to determine the incidence of certain physical characteristics of these diseases that may be demonstrable radiologically and to investigate the ability of the x-ray method to reveal these lesions. The diagnoses included regional enteritis in 74 cases, tuberculous enteritis in 12, primary carcinoma in 23, lymphoma in 20, other malignant neoplasms in 8, carcinoid in 14, and benign tumors in 21.

The three methods of study used included routine interval films, the use of the small intestinal enema, and the employment of the Miller-Abbott tube in cases of ileus. Details as to symptoms localizing diagnostic methods, location of disease, length of lesion, and multiplicity of lesions are tabulated. Inflammations, lymphosarcomas, carcinoids, and benign tumors were more common in the ileum than in the jejunum. Carcinomas were more frequent in the jejunum. Lesions of regional enteritis were longer than 8 cm. in 90 per cent of the cases. More than half the tuberculous lesions were less than 8 cm. in length. Most neoplastic lesions produced defects of less than 6 cm. The inflammatory lesions were frequently multiple, as were carcinoids, and lymphosarcomas. Only 1 of 23 carcinomas was multiple.

Bleeding was relatively uncommon in regional enteritis but occurred in a third to one-half the cases of tuberculosis or neoplasm. Diarrhea was frequent in inflammations but uncommon with primary neoplasms. Abdominal pain was present in a large number of cases, but was not recorded in 8 of the 14 carcinoids.

Roentgen examination revealed abnormality in 90 per cent of 133 cases examined. The most practical method of examination is the small intestine study following the ingestion of a non-flocculating suspension of barium sulfate.

Six tables.

JOHN P. FOTOPOULOS, M.D.
University of Michigan Hospital

Congenital Stenosis and Atresia of the Small Intestine. Thomas C. Moore and George E. Stokes. Surg., Gynec. & Obst. **97:** 719–730, December 1953.

Congenital atresia and stenosis are the commonest causes of neonatal obstruction of the small intestine. At the Indiana University Medical Center during a twenty-five-year period, 40 cases of this anomaly were seen; in 23 the obstruction was duodenal and in 17 jejunal or ileal. Five of the infants included in this study were born at the institution during a period in which there were approximately 30,000 births, an incidence of 1 in 6,000 births. The atresias were due to a thin imperforate diaphragm across the lumen of the bowel. The stenoses were of varying degrees.

Duodenal Obstructions: The diagnosis was suggested by persistent vomiting from birth in cases of atresia and completely obstructing stenosis, and by symptoms of partial duodenal obstruction in the early weeks and months of life in the remaining cases of stenosis. Abdominal distention was less pronounced than when the obstruction was jejunal or ileal, and, when present, was limited to the epigastrium. A flat film of the abdomen usually established the diagnosis of duodenal obstruction in most cases of complete obstruction. Occasionally lateral films were used. The stomach and duodenum up to the point of obstruction were distended with air and there was a conspicuous absence of air in the remainder of the intestinal tract. The instillation of an opaque substance, especially barium, offers a potential hazard from vomitus aspiration. In the cases of partial obstruction due to stenosis, the flat films were often inconclusive and in these cases small amounts of Lipiodol were frequently helpful in demonstrating the presence and location of duodenal obstruction.

Other congenital anomalies which may produce similar symptoms are annular pancreas, congenital bands, duodenal duplications, and the concomitants of intestinal malrotation, all of which also require operative intervention.

Jejunal and Ileal Obstructions: With jejunal or ileal obstruction, flat films of the abdomen showed marked gaseous distention of the small intestine and established the necessity for prompt surgical intervention. The number of distended loops often suggested the most likely location of obstruction, whether high or low. Even with high jejunal obstruction, the distention was greater than at the duodenal sites. Large collections of air were found in the lower ileal obstructions. Occasionally, upside-down roentgenograms were taken in an effort to delineate the distal collection of air more clearly. In differential diagnosis, congenital bands and meconium ileus secondary to cystic fibrosis of the pancreas should be considered. In the latter instance, small gas bubbles can also be seen roentgenologically in the viscid meconium at the level of the obstruction.

An attempt at operative relief of the duodenal ob-

struction was made in 15 cases, and 10 of 12 patients operated upon during the last thirteen years recovered. Only 1 of the 9 patients with jejunal or ileal atresia who were treated by anastomosis was still living at the time of the report.

Eight illustrations, including 4 roentgenograms; 5 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Roentgen Examination of the Colon. Paul C. Hodges. J.A.M.A. **153**: 1417–1421, Dec. 19, 1953.

Medium and large neoplasms, diverticulosis, diverticulitis, and ulcerative colitis can be diagnosed dependably by reasonably experienced radiologists, almost without regard to the particular technic employed. For the detection of small polyps beyond the reach of the proctoscope, special radiologic procedures are required. These have to do with preparation of the patient, the nature and concentration of the medium, and the conduct of the examination itself.

Preparation for examination is most important. The patient is allowed only clear fluids for twenty-four hours prior to examination. The author deprecates the use of "cleansing enemas," preferring to use 2 ounces of castor oil on the day preceding the examination.

Insoluble barium sulfate, the standard contrast material for study of the alimentary tract for over thirty years, remains a most satisfactory medium. The newer preparations, such as "micro barium," "colloidally stabilized barium," etc., appear to offer but little advantage. The ideal homogenized suspension for use as a barium enema should hold the bulk of the barium in suspension for long periods of time and yet deposit on the colon mucosa a thin film that will persist for from ten to fifteen minutes after the main portion of the enema has been expelled. The opacity and viscosity should also be capable of adjustment. The author uses synthetic sodium carboxymethylcellulose (CMC) to prepare his barium sulfate suspensions. An aqueous mucilage of the gum is mixed with barium sulfate and water and run through a colloid mill, though it is also possible to mix powdered CMC with dry barium sulfate and add water as the material is to be used.

The different technics available for studying the colon are briefly mentioned. A modification of the apparatus of Templeton for double contrast studies (Templeton and Addington: J.A.M.A. **145**: 702, 1951. Abst. in Radiology **58**: 297, 1952) now in use at the University of Chicago is described in detail (see Am. J. Roentgenol. **71**: 102, 1954). The use of 70 mm. roll film and a high-speed reflector camera for survey examination of the colon is briefly mentioned.

One illustration.

JOHN P. FOTOPOULOS, M.D.
University of Michigan Hospital

Program for the Detection of Colonic and Rectal Polyps. Cesare Gianturco and George A. Miller. J.A.M.A. **153**: 1429–1430, Dec. 19, 1953.

The Carle Clinic (Urbana, Ill.) plan for colon study includes a barium enema study, with fluoroscopy and high-voltage radiography, supplemented by rectoscopy in asymptomatic patients and by sigmoidoscopy in patients with bleeding or other symptoms. The "high-voltage" (120 kv.) technic is described in detail. Proctosigmoidoscopy is done on the day prior to roentgen study of colon, in order to avoid distention of the colon with air at the time of the barium study.

This program resulted in the discovery of 14 cases of early and curable carcinoma of the colon in 4,851 visual and x-ray examinations. The routine use of the proctoscope by the general practitioner should lead to the discovery of polyps in from 8 to 10 per cent of adult patients. With the co-ordinated program described here, polyps should be disclosed in from 10 to 15 per cent of adult patients, regardless of symptoms.

One roentgenogram; 1 table.

JOHN P. FOTOPOULOS, M.D.
University of Michigan Hospital

Diverticulitis and Its Confusion with Carcinoma in the Sigmoid Colon. Stanley L. VanderVelde. J. Kansas M. Soc. **54**: 549–552, December 1953.

The author discusses the differential diagnosis between diverticulitis and carcinoma of the colon. The conditions occur in the same age group (over forty years), and both are most commonly encountered in the left side of the bowel. Both produce bleeding, although this symptom is much more common in carcinoma. Of patients having diverticulitis, the percentage who have blood in the stool ranges from 5 to 17 in different series. Low abdominal cramping, diarrhea, or constipation, and a sensation of incomplete defecation may be associated with either condition.

The two processes may occur in one patient, but this is uncommon. No etiologic relationship between the two has been established.

Diverticulosis occurs in almost equal numbers in the two sexes, but diverticulitis is found in men almost twice as frequently as in women. Fistula formation is considered to arise rather frequently in diverticulitis. It is more common in males, since the female bladder is protected by the uterus

In favor of the diagnosis of carcinoma is a history of fairly good health with no previous colon difficulty, loss of weight, and blood in the stools. Colon distention is found more often with carcinoma than with diverticulitis.

Uncomplicated diverticulitis, the author believes, is a medical and not a surgical problem. He presents the case histories of three patients who underwent surgery for what were thought to be carcinomas of the sigmoid, only to have pathologic examination show the masses to be due to diverticulitis.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Diagnostic and Therapeutic Considerations of Intussusception. H. Reichard Kahle and Clarence T. Thompson. Surg., Gynec. & Obst. **97**: 693–701, December 1953.

The clinical picture of intussusception is classical, with abrupt onset of symptoms in a child previously in excellent health. The patient screams, presumably with pain, and assumes a posture of abdominal distress. Pallor and sweating may appear, followed by vomiting. The stools frequently become bloody. An abdominal mass is usually palpable, either abdominally or rectally. The symptoms may be intermittent, the child appearing relatively normal between attacks. The history obtained from the parent is important.

Of 71 cases of intussusception comprising the two most recent series at Charity Hospital of Louisiana (1939–49, 1950–52), 66 were observed in the first year of life; 55 of these occurred between the third and

eighth month. The incidence was greater in males.

From 1904 to 1938, in a total of 88 patients under two years of age with intussusception there was a mortality of 63.7 per cent. In the 1939–49 series of 54 cases the mortality was 25.9 per cent. From 1949 to 1952, 17 cases were seen, with a 17.6 per cent mortality. If 2 patients moribund on arrival are excluded, the mortality for the last 25 cases was only 4 per cent. Earlier hospitalization and therapy account for the lowered death rate.

The authors have found that barium enema roentgenograms are seldom necessary for diagnosis and they rarely use the barium enema as a method of reducing the intussusception. They regard with some favor, however, the suggestion of Ravitch and Morgan (Ann. Surg. **135:** 596, 1952. Abst. in Radiology **60:** 458, 1953) that the latter measure be carried out routinely in all patients suspected of intussusception, to be followed by laparotomy through a McBurney's incision, regardless of the apparent results, to confirm or complete the reduction. All manipulations should be gentle. The hydrostatic pressure should not exceed 3 feet, and no more than three attempts at reduction should be made. The surgeon should be part of the team that shares in the decision to attempt reduction by enema.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Intussusception in the Adult, with Emphasis on Retrograde Type. Ralph A. Deterling, Jr., Robert D. O'Malley, and William Knox. Arch. Surg. **67:** 854–864, December 1953.

An analysis of 40 cases of adult intussusception is presented, with histories of 5 unusual cases of reverse intussusception, 4 of which were thought to be caused by the presence or sudden withdrawal of a Miller-Abbott tube. The other case of reverse intussusception occurred through an enterocolic fistula secondary to the presence of an abdominal lithopedion. One case of isoperistaltic intussusception of the proximal jejunum thought to be due to a Miller-Abbott tube is also presented.

A barium enema study or upper gastrointestinal series was diagnostic in 19 (70 per cent) of 27 cases in which these examinations were used. The clinical and roentgenographic features essential to a diagnosis of intussusception are: (*a*) obstruction to the free passage of barium, (*b*) gradual narrowing of the lumen proximal to the lesion, (*c*) marked narrowing of the longitudinal mucosal pattern at the site, (*d*) local widening of the bowel with the usual semicircular mucosal markings, (*e*) palpable mass at the site, and (*f*) change in position and shape following defecation.

The incidence, mechanism and etiology, signs and symptoms, and treatment of intussusception are discussed. In 7 cases the intussusception was reduced by barium enema or reduction occurred spontaneously.

One roentgenogram; 2 photographs; 4 tables.

PETER P. WERLE, M.D.
Detroit, Mich.

Studies on Contrast Filling of the Normal Appendix. Sv. A. Chrom and C. E. Gudbjerg. Acta radiol. **40:** 583–592, December 1953.

Sodium carboxymethylcellulose (CMC) added to barium sulfate suspension was used in a series of 64 subjects, in an attempt to demonstrate the appendix. CMC is made of pure cellulose and is used chemically in a water-soluble form. Animal experiments have shown that the substance is harmless, but it seems to be affected by intestinal enzymes, which are reported to bring about a certain disintegration evidenced, among other things, by a decrease in the viscosity of aqueous solutions.

A heaped tablespoonful of CMC was added to a glass of barium sulfate suspension. After vigorous stirring, the mixture was ingested, together with soda-water or beer, by the fasting subject. As far as possible, the x-ray examinations were carried out within the third, sixth to seventh, and tenth to eleventh hours after ingestion of the meal.

In a series of 42 cases, filling of the appendix was obtained in 40. In 33 the appendix filled to the tip; in 6, there was scattered, segmented filling without a visible apical portion, and in 2 filling was limited to the base. In a second series of 33 young men from eighteen to twenty-seven years of age, filling of the appendix was observed in 78.8 per cent.

The appendix failed to fill in 4 of 12 women who were subjected to gynecologic operations shortly afterward. In all 4 of these cases definite fibrous changes were found in the appendix.

Eight roentgenograms; 6 tables.

G. M. RILEY, M.D.
Shreveport, La.

Solitary Air Cyst of Peritoneal Cavity. William L. Hughes and Ralph C. Greene. Arch. Surg. **67:** 931–936, December 1953.

A case of a solitary large unilocular cyst of the sigmoid peritoneum in a 45-year-old female is reported. The authors were unable to find reference to a similar lesion in the literature.

The patient presented herself because of a central abdominal mass, 10-lb. weight loss, occasional abdominal pain, and vomiting. The mass appeared one week following the first severe attack of vomiting. It was palpable in the right upper quadrant, moving easily on deep inspiration. There was no tenderness, rigidity, or rebound tenderness. The laboratory findings were all within normal limits.

A roentgenogram revealed a rounded, symmetrical area of radiolucency in the mid-abdomen without evidence of internal structure. This was believed to be a cyst, but the intense radiolucency indicated that it might contain air or gas. An intravenous pyelogram and barium enema study were negative aside from diverticulosis as disclosed on the latter. There was no demonstrable connection between the lumen of the colon and the air-filled cyst.

At laparotomy a cystic mass the size of a large grapefruit was found to arise from the mid-portion of the sigmoid colon on the antemesenteric border. It was attached to the bowel wall by a pedicle of fibrous tissue 5 cm. in length and 2 cm. in diameter. The cyst was accidentally incised and odorless gas escaped.

Microscopically there was no evidence of an epithelial lining, but there was an inner circular and outer longitudinal layer of smooth muscle resembling that seen in the large intestine present in the wall of the cyst. The external layer was serosa identical with that of the peritoneal covering of the large bowel.

The authors offer two possible explanations of the pathogenesis: (1) partial obstruction to the neck of an infected diverticulum, allowing air to enter the lumen under pressure and there remain entrapped, the orifice

subsequently becoming occluded and sealed by fibrosis; (2) derivation from a congenital duplication of the large intestine.

Two roentgenograms; 3 photomicrographs; 1 drawing.

DONALD OTTO, M.D.
Detroit, Mich.

Cholecystography in the Presence of Liver Disease. A. David Etess and Bernard Straus. New England J. Med. **249:** 930–932, Dec. 3, 1953.

Thirty-five non-jaundiced patients with impaired liver function were examined by cholecystography at the Veterans Administration Hospital in the Bronx, N. Y. The degree of liver impairment was determined solely by the bromsulfalein test, in which the degree of retention of the dye is measured forty-five minutes after the injection of 5 mg. per kilogram of body weight. All cholecystograms were made with iodoalphionic acid (Priodax) in doses of 6 gm., repeated the second day if there was failure of visualization after the first dose.

The critical level of bromsulfalein retention appeared to be between 20 and 23 per cent. Five patients whose liver-function tests fell within this range had faint visualization of the gallbladder. Seven patients with higher degrees of retention showed no visualization, even after a second dose. In the remaining 23 patients, on the other hand, with retentions between 5 and 20 per cent, visualization was normal.

In 2 cases examinations were done at different stages of progressive hepatic impairment. Normal visualization of the gallbladder was recorded in both patients when the bromsulfalein retention was under 20 per cent. Repetition of the cholecystograms, when the retention was 28 per cent in one case and 30 per cent in the other, failed to show visualization.

The authors suggest that failure of visualization of the gallbladder when the bromsulfalein level is less than 20 per cent is suggestive of gallbladder as opposed to liver disease.

No toxic effects were observed from the use of iodoalphionic acid in the patients with hepatic damage.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Cholecystography in Portal Cirrhosis Without Jaundice. Charles L. Cuniff, Mario A. Dolan, and Carroll M. Leevy. Gastroenterology **25:** 557–564, December 1953.

This study was carried out on 50 patients without jaundice in whom aspiration liver biopsy revealed portal cirrhosis. Telepaque was used for visualization of the gallbladder, in the usual dosage of six tablets. The procedure was repeated with a double dose in 12 patients whose tests showed poor or non-visualization.

Visualization of the gallbladder was considered as good in 14 patients (28 per cent), poor in 20 (40 per cent), and absent in 16 (32 per cent). In 9 patients with non-visualization, a double dose produced no change in 6, poor visualization in 2, and good visualization in 1. Gallbladder stones were demonstrated in 9 (18 per cent) cases.

There was a direct correlation between the severity of the clinical symptoms and visualization of the gallbladder. Non-visualization occurred repeatedly in 2 patients with hepatic fetor, in 2 patients who had been in hepatic coma, and in 5 patients with ascites. Of 12 patients with ascites, only 1 had good visualization. As a general rule, liver function tests were more abnormal in patients with non-visualization of the gallbladder. Visualization could best be correlated with the bromsulfalein and cephalin flocculation tests. Bromsulfalein retention of more than 30 per cent was associated with good visualization. The cephalin flocculation test was more frequently positive in patients with non-visualization. There was a decreased incidence of visualization in those patients exhibiting the greatest amount of fibrosis histologically.

The authors conclude that non-visualization of the gallbladder in patients with severe liver disease should be attributed to decreased hepatic reserve. On the other hand, in patients with minor liver changes, cholecystitis, cholelithiasis, or other non-hepatic factors should be considered as responsible for the non-visualization.

Two tables.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Cholecystography in Infants. Ruth C. Harris and John Caffey. J.A.M.A. **153:** 1333–1337, Dec. 12, 1953.

The authors carried out 27 cholecystographic examinations in children under three years of age, and obtained 15 successful visualizations of the gallbladder. Priodax and Telepaque were used in most cases, administered orally in doses of 0.15 gm. per kg. Doubling or tripling these doses was without toxic effect. Three patients were given Urokon intravenously (0.7 gm. per kg. of weight), but no visualization was obtained.

Satisfactory demonstration of the gallbladder was obtained in 12 infants under six months of age. The gallbladder shadow was greatest between the fourth and ninth hour after the ingestion of the contrast agent in infants with normal biliary tracts. When the gallbladder shadow was demonstrable on only one of a series of films, it was seen on that made at the fourth, fifth, or ninth hour. The authors reiterate the necessity of taking serial films earlier in young children than in adults.

Eight roentgenograms; 2 tables.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Acute Gaseous Cholecystitis. Ernest A. Ryan, E. Harrigan, and S. F. Penny. Canad. M. A. J. **69:** 606–610, December 1953.

A case of gaseous cholecystitis is reported and the literature is reviewed briefly. The condition occurs predominantly among men, in a ratio of 3 to 1. Older age groups are chiefly involved and gallstones have been present in at least 87 per cent of the reported cases. In over 87 per cent the organisms involved were anaerobic gas-forming bacilli.

Clinically the condition is indistinguishable from attacks of acute cholecystitis in which gas-forming organisms are not involved. The gas does not begin to appear until about twenty-four to forty-eight hours after the onset of the attack. Evidence is cited that the anaerobic gas-forming organisms come from the liver, where they appear normally, and that their development in the gallbladder is secondary to and not responsible for the development of the acute cholecystic process.

In the case reported by the authors, interstitial air was seen on "flat-plate" x-ray examination of the abdo-

men. This appeared to be in the submucosal layer of the gallbladder and study of the gross surgical specimen confirmed this. Gas was also seen in the gallbladder lumen, with the presence of an air-fluid level.

Differentiation between acute gaseous cholecystitis and a cholecystenteric fistula is based on the presence of interstitial gas in the gallbladder wall, the fluid level in the gallbladder, and the absence of radiologic evidence of air communicating with air in the bowel. In cholecystitis the gallbladder is distended with gas, whereas in the presence of a fistula it is small or normal in size. The lack of communication between the gallbladder and gastrointestinal tract as demonstrated by an upper gastrointestinal series or barium enema study is a feature in making this distinction.

The ideal treatment of acute gaseous cholecystitis is prompt surgical removal of the gallbladder, with antibiotic therapy. Since perforation invariably occurs in untreated cases, there is danger of resulting infection in the gallbladder area. A "flat-plate" examination of the abdomen is recommended in any acute abdominal condition where the diagnosis is not certain and in any severe case of acute cholecystitis, especially in elderly individuals.

Two roentgenograms; 1 photomicrograph.

MASON WHITMORE, M.D.
Jefferson Medical College

Milk of Calcium Bile. Louis Pelner and Walter Puderbach. Gastroenterology **25:** 553–556, December 1953.

"Milk of calcium" bile is a mixture of calcium salts with the bile in the gallbladder, which results in the gallbladder appearing densely opaque on the plain roentgenogram. In all of the case reports of this condition, one or more calculi have been demonstrated in the cystic duct. It has been shown that calcium carbonate may be precipitated from the gallbladder bile if a complete or almost complete obstruction of the cystic duct is present with an associated low-grade cholecystitis. This calcium may be deposited on already existing stones or may settle out as a calcium substance of putty-like consistency.

The clinical symptoms do not differ from those of a cholelithiasis, but the diagnosis can be made preoperatively if a plain radiograph is obtained before a contrast medium is given. If the medium has been given, the diagnosis may be suspected if the shadow of the gallbladder does not change following a fatty meal.

A case is presented which was confirmed surgically.

One roentgenogram.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Hepatic Venous Hum in Cirrhosis of Liver. A. J. S. McFadzean and John Gray. Lancet **2:** 1128–1130, Nov. 28, 1953.

A case of diffuse hepatic fibrosis is reported in which a venous hum was heard over a wide area. A similar but louder hum was heard on direct auscultation of the liver at operation. Occlusion of the hepatic artery abolished the hum. Hepatic arteriography at necropsy showed numerous arteriovenous shunts between branches of the hepatic artery and of the portal vein, and it is concluded that these shunts were responsible for the hum.

Direct auscultation of the liver at operation revealed a hum in 5 of 9 cases of diffuse hepatic fibrosis in which a hum was not heard previously. In the absence of facilities for hepatic arteriography at operation a hum so demonstrated may aid in the selection of cases for treatment by ligation of the hepatic artery.

A greatly increased arterial vascular bed was seen in the arteriogram of the case reported. This increase has been found not only in other cases of diffuse hepatic fibrosis but also in biliary cirrhosis and in carcinoma of the liver.

Two arteriograms; 1 drawing.

THE DIAPHRAGM

The Problem of Hiatus Insufficiency. J. Eberl. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 693–699, December 1953. (In German)

Symptoms of hiatus insufficiency may simulate angina pectoris, ulcer, obstipation, etc. Vague colic, vomiting, dysphagia, girdle pain, and signs of reflex irritation elsewhere in the gastrointestinal tract are frequently present. Symptoms are sometimes intermittent. Cardiac pain referred to the left arm is occasionally observed. Many cases are without symptoms.

The patient is placed in the Trendelenburg position, and the barium-filled esophagus is observed fluoroscopically in forced inspiration. Rotation in the oblique positions is of value. Films are made in whatever position best shows the abnormal appearance. In the average type of hernia, in which a definite sac is visualized and pyloric mucosa identified, there is a little difficulty in diagnosis. In many cases, however, it is difficult or impossible to differentiate definitely between true herniation and enlargement of the esophageal ampulla. Occasionally, in the latter condition, on full inspiration normal esophagus may be identified below the enlargement, differentiating it from the true hiatus hernia. The author considers ampullar enlargement as a functional esophageal diverticulum; it is important that this be differentiated from the Barsony diverticulum or herniation, which is of greater significance.

The recognition of insufficiency of the hiatus as a predisposing cause of hernia is extremely difficult, but the transitory appearance of a sac under pressure, on forced respiration or on coughing, will occasionally demonstrate this finding.

Five roentgenograms; 6 drawings.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Neurofibroma of the Diaphragm. Richard H. Sweet and Thomas Gephart. New England J. Med. **249:** 939–940, Dec. 3, 1953.

A case of neurofibroma of the diaphragm is reported from the Massachusetts General Hospital, where the patient was referred after a shadow over the diaphragm was found on a film made during an upper respiratory infection. Further examination revealed a smooth-margined area of density extending from the left leaf of the diaphragm and moving synchronously with that structure. A small firm tumor was uneventfully resected.

The authors emphasize the rarity of primary tumors of the diaphragm, of which less than 40 are recorded in the literature. Only one of those previously reported was a neurofibroma. Since half of the diaphragmatic tumors have been found to be malignant, early diagnosis and resection are considered advisable.

One photograph; 1 photomicrograph.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

The Diaphragm in the Puerperium. R. Grenville-Mathers and H. J. Trenchard. J. Obst. & Gynaec. Brit. Emp. **60**: 825–833, December 1953.

The authors' interest in the behavior of the diaphragm in women arose from the consequences that this may have during pregnancy on a pulmonary tuberculous lesion. The excursion of the diaphragm was determined by roentgenography of the chest, with exposure of the same film in inspiration and then in expiration. This procedure was carried out immediately before delivery and during the puerperium.

It was found that immediately after delivery the diaphragmatic respiratory excursion was very much diminished, with a tendency to return to normal late in the puerperium (six weeks). Before delivery, breathing seems to be predominantly diaphragmatic, but immediately after delivery there is a relative increase in the costal element of respiration, which coincides with the decrease in diaphragmatic respiratory excursion. The level of the diaphragm falls after delivery and during the succeeding week, and this fall can, if it is desired, be counteracted by the induction of a pneumoperitoneum.

One roentgenogram; 8 tables.

THEODORE E. KEATS, M.D.
University of California

THE MUSCULOSKELETAL SYSTEM

Skeletal Tuberculosis. A Roentgenographic Survey with Reconsideration of Diagnostic Criteria. Maxwell H. Poppel, Lewis R. Lawrence, Harold G. Jacobson, and Joseph Stein. Am. J. Roentgenol. **70**: 936–963, December 1953.

This report encompasses an analytic study of 156 cases of bone and/or joint tuberculosis followed for ten years. The authors stress particularly the unusual roentgen manifestations which had little mention in the past. This prime purpose is "to document in detail the unique and little known osseous aspects of this disease and to illustrate. . .their relatively frequent occurrence." The skeletal lesions have been catalogued as follows: (1) axial tuberculosis (spine and pelvis); (2) rib tuberculosis; (3) disseminated osseous tuberculosis; (4) peripheral osseous tuberculosis.

There were 9 cases of tuberculosis of the cervical spine, involving principally the second, fifth, and sixth cervical segments. These were primarily lytic in appearance.

Lesions of the dorsolumbar spine, observed in 36 cases, were classified as lytic, productive, mixed, and proliferative. The lytic lesions, which were most numerous, appeared as circumscribed, radiolucent defects, solitary or multiple, in a single vertebral body or in several. Other roentgen manifestations such as destruction of the intervertebral disk space and paravertebral abscesses were sometimes present. The productive lesions showed vascular involvement which gave root to bone "sclerosis" or production. Mixed lesions of the dorsolumbar spine were occasionally noted.

Tuberculosis of the pelvic girdle is overwhelmingly limited to the sacroiliac synchondrosis. It may be lytic, blastic, or of mixed type. It has frequently been misinterpreted as rheumatoid arthritis, non-specific inflammatory or suppurative arthritis, and finally as neoplastic, i.e., Hodgkin's disease.

In the majority of instances tuberculous rib lesions occur independently of vertebral, pleural, or parenchymal disease. The lesions are predominantly lytic.

The authors cite Auerbach (Quart. Bull., Sea View Hosp. **6**: 117, 1941), who contends that skeletal involvement is related to hematogenous dissemination which occurs during the active phase of the original primary complex. This results in a "seeding" of the bone marrow throughout the skeletal system. This is thought to account for the skipping of vertebrae which is seen frequently in lesions of the spine.

Peripheral osseous tuberculosis frequently occurs in the small tubular bones as a diaphysitis. Peripheral osseous tuberculosis of the greater trochanter of the femur must be differentiated from osteitis secondary to non-specific peritendinitis, rheumatoid osteopathy and, rarely, lymphoma.

One-third of the authors' patients had either associated active, chronic pulmonary or coexisting renal disease. Twenty per cent showed bone lesions which were associated with an active pulmonary lesion, while 20 per cent had coexistent tuberculosis of either the urinary system or the genital tract.

Nine comprehensive tables give a rather complete analysis of all the lesions noted. Histories of 28 cases are given in adequate detail.

Sixty-five roentgenograms.

JOHN F. BERRY, M.D.
Louisville General Hospital

Concerning the Presumed Action of Tuberculosis in the Production of Hypertrophic Osteopathy of Pierre-Marie. C. Calamosca. Ann. di radiol. diag. **26**: 411–413, 1953. (In Italian)

Because of the conflicting reports in the literature concerning the relationship between hypertrophic osteopathy of Pierre-Marie and pulmonary tuberculosis, and the lack of any significant statistical data on the subject, the author undertook the study of this relationship in his own material. He points out that, since the osteopathy is most often clinically silent, a routine roentgen examination is necessary to uncover its incidence. A survey of the hands and limbs of 500 tuberculous patients failed to reveal a single case of periosteal reaction suggestive of the osteopathy of Pierre-Marie. The patients represented all age groups and disease ranging from several weeks to more than fifteen years duration. It is concluded that the osteopathy of Pierre-Marie is not related etiologically to tuberculosis.

[A paper by Wierman, Clagett, and McDonald, Articular Manifestations in Pulmonary Diseases, J.A.M.A. **155**: 1459, Aug. 21, 1954, is of interest in this connection. C.V.C.] CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Roentgen Studies of Bone Structure in Albers-Schönberg Disease. G. Liess and E. Dörffel. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 713–727, December 1953.

From the hereditary and clinico-prognostic standpoint, Albers-Schönberg disease has been divided into four types (Cocchi). The authors consider only the extreme types: (*a*) generalized involvement with tendency to fractures, optic atrophy and anemia, and osteosclerosis of the metaphyses; (*b*) a familial, clinically low-grade osteosclerosis of uniform distribution as demonstrated roentgenographically. In their own 4 cases they have observed the following x-ray findings: (1) fairly homogeneous, extensive sclerosis of all bones; (2) decreased density of the borders of the epiphyses and

short bones; (3) stippled density in the bone ends; (4) transverse and longitudinal striations, particularly in the bone ends; (5) narrowing of the medulla; (6) a striped pattern in the body of the iliac bone.

Longitudinal sclerotic lines in the ends of the long bones may be found occasionally in normal knees, osteopoikilosis and chondroangiopathia calcarea. Transverse striations are found as normal growth lines, in such systemic diseases as myxedema, scurvy, rickets, etc., in metal poisoning (phosphorus, strontium, bismuth, and lead), and in certain hormonal conditions.

The authors consider diffuse osteosclerosis of purely endosteal type with narrowing of the medulla, beginning in early infancy and showing few or no clinical symptoms, as a distinct entity to be differentiated from Albers-Schönberg disease, and believe that it should be called "familial diffuse osteosclerosis."

Seventeen roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Osteogenesis Imperfecta. A Case Report. L. W. Graffeo, L. H. Tisdall, and J. R. DeVita. Am. J. Obst. & Gynec. **66:** 1333–1336, December 1953.

The author reports the spontaneous delivery by a 32-year-old primigravida of an infant with findings characteristic of osteogenesis imperfecta. The mother and grandmother were also afflicted. The disease, with definite familial and hereditary tendencies, is characterized by fragility of bone, manifested by numerous fractures under conditions of minimal stress. Blue sclerae, otosclerosis, and relaxed ligaments may be associated.

In the congenital form the infant seldom survives; if so, it remains a chronic invalid with gross skeletal deformities, dwarfism, and generalized muscular atrophy. The long bones are chiefly affected; also the calvarium and ribs. The cortex is thin and osteoporotic, with wide medullary cavities. Apparently bone formation remains in the primary fibrous state either because there is failure of the osteoblast to form periosteal bone or the normal ratio of absorption and bone formation is lost. The infant in this report survived but was seen at thirteen months with a fractured left femur. The mother later gave birth to a normal child.

Two roentgenograms; 1 photograph.

WARREN A. NAFIS, M.D.
Jefferson Medical College

True Chondro-osteodystrophy (Morquio's Disease). John J. Toma. S. Clin. North America **33:** 1765–1774, December 1953.

True chondro-osteodystrophy (Morquio's disease) shows degenerative cartilage changes and defective ossification throughout the entire skeleton. Conspicuous physical features are: dwarfism, short neck, short trunk, kyphosis, pigeon breast, cubitus varus, and genu valgum. Three cases are reported with roentgenographic findings explaining these changes. They are: wedging of vertebrae with wide disk spaces, osteoporosis of the spine with a "slipper-shoe" or tongue-like appearance of the anterior surfaces of the vertebrae, compressed cervical vertebrae, impression of atlas and axis into the base of the skull, fragmented and fused ossification centers of the long bones, and wide hip joints with flattened, sclerotic capital epiphyses.

The prognosis is not favorable for longevity. Treatment is directed to correcting dislocated hips and joint deformities and to preventing early deformities of the hands.

Thirteen roentgenogram; 4 photographs.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Chondrodysplasia (Achondroplasia) in One of Dizygotic Twins. Rolv K. Slungaard and Lloyd E. Harris. Am. J. Dis. Child. **86:** 788–794, December 1953.

A case of severe chondrodysplasia with involvement of most of the bones of the skeleton and marked flattening of the vertebral bodies, in one of twin boys, is presented, with suggestions as to the cause of this abnormality.

Chondrodysplasia is characterized by faulty development of the cartilage and growth of bone, but the fault occurs only in the bones of non-membranous origin. Periosteal formation of bone is normal. The disturbance involves chiefly longitudinal growth, resulting in widening of the epiphyses, irregularity of the epiphyseal lines, and shortened bones as seen on the x-ray film. Patients are of typically short stature. The trunk is of normal length. The hands are broad. The head appears large, with sunken nasal bridge and prominent forehead and lower jaw. Chondrodysplasia occurs about once in 10,000 births. The occurrence of the condition in a dizygotic twin can be expected, statistically, to occur once in about 1,500,000 births. Ten such cases are said to have been previously reported.

Chondrodysplasia in one of dizygotic twins rules out disturbances of the maternal organism as a cause. In the present case the two placentas were fused in the center, and the environmental conditions of the two fetuses were presumably similar. A change in the genetic pattern of one twin would seem to be the explanation.

Nine roentgenograms; 2 photographs.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

Some Clinical Caprices of Multiple Myeloma: 15 Case Reports from a Study of 75 Cases. Steven O. Schwartz and Marne Cataldo. Ann. Int. Med. **39:** 1267–1280, December 1953.

The authors report 15 cases of multiple myeloma chosen from a series of 75 to illustrate the diverse guises in which the disease may make its appearance. The clinical features alone do not permit a diagnosis. Roentgenography, urine examination for Bence-Jones protein, and serum globulin determination are important aids, but only bone marrow studies can establish the presence of the disease. In the authors' cases the marrow was replaced to the extent of about a third to almost 100 per cent by plasma cells.

In the roentgen study, the skull, pelvis, vertebrae, and ribs are of chief concern. Osteolytic lesions were present in 67 of the authors' 75 cases. Most commonly the lesions appear as punched-out areas with little or no surrounding osteoblastic activity. This is particularly true of the flat bones, as the skull and pelvis, but any combination may occur, as osteoporosis and osteolytic lesions, sharply circumscribed lesions, poorly circumscribed lesions simulating metastases, and severe bone destruction resulting in a paper-thin cortex or occasionally no cortex at all. New bone formation is unusual but is seen on rare occasions.

Hematogenous Osteomyelitis in Young Children. R. D. Heath and Jesse T. Nicholson. S. Clin. North America **33**: 1667–1679, December 1953.

Hematogeneous osteomyelitis in young children may be a severe, acute, systemic disease or a mild local infection. The infection usually originates in the metaphysis of the bone, spreading through the medullary cavity, out to the periosteum, and often invading the adjacent joint. Symptoms and signs may mimic other diseases.

Treatment consists of antibiotic medication, aspiration of joint effusions, and immobilization of limbs to prevent dislocations and pathological fractures.

Roentgenographic findings may be absent for ten to twenty days, following which scattered areas of destruction appear in cancellous and cortical bone, with periosteal reaction. These changes progress extensively in spite of adequate treatment, before healing occurs. Deformities may result from epiphyseal involvement.

Sixteen roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Aneurysmal Bone Cyst. Further Observations. Louis Lichtenstein. Cancer **6**: 1228–1237, November 1953.

Since 1949 the author has observed 17 cases of aneurysmal bone cysts. They were encountered most frequently in children, adolescents, and young adults, showing no sex predilection. The widespread distribution of the lesions suggests that they may occur in any bone. Most commonly the long bones, vertebral column, and the flat bones are affected.

The most frequent presenting complaint is pain, usually of several months duration. If the cyst occurs near a joint, there may be limitation of motion; if the location is superficial, swelling and tenderness may be evident; if near nerves or the spinal cord, referred pain may be present.

The characteristic roentgen finding, irrespective of localization, is expansion, with the bone appearing cystically transformed and often ballooned-out. In the long bones the expansive lesion tends to bulge eccentrically far beyond the neighboring intact cortical surface. The periphery is faintly outlined by a delicate shell of periosteal new bone. The lesion is often mottled, and at times traversed by fine septa. In vertebrae the expansion is less; otherwise the appearance is similar. In the flat bones there is more often symmetrical expansion involving the entire width of the bone.

The view is again expressed that this slowly progressive lesion probably arises as a result of persistent disturbance in local hemodynamics leading to a markedly increased venous pressure and engorged vascular bed within the affected bone area. Because of the steady progression, early and prompt conservative therapy is indicated. Simple curettement suffices for small lesions. For large bulging masses, removal of the extraosseous bulk is feasible. Roentgen irradiation in moderate dosage may be used either as the primary measure or as a supplement to surgery.

Thirteen roentgenograms; 2 photographs; 1 photomicrograph.

RICHARD E. OTTOMAN, M.D.
University of California, Los Angeles

Cervical Spondylosis Simulating Motor-Neurone Disease. L. A. Liversedge, E. C. Hutchinson, and J. B. Lyons. Lancet **2**: 652–655, Sept. 26, 1953.

Eight cases of cervical spondylosis are reported which show the close clinical resemblance that may exist between certain manifestations of cervical spondylosis and those of motor neurone disease, both in its guise of amyotrophic lateral sclerosis and in that of progressive muscular atrophy. The changes in the spine were demonstrated roentgenographically.

Four roentgenograms.

The Lumbar Intervertebral Disk Lesion. A. R. Murray. M. J. Australia **2**: 884–888, Dec. 12, 1953.

Pathologically the lumbar intervertebral disk lesion is a degenerative process, which has a propensity for healing in the proper circumstances. Acute or persistent stress may produce or aggravate the disease. The primary stages of degeneration may be accompanied by back pain due to irritation of intraspinal structures or to localized muscle spasm or secondary strain of extraspinal myofascial tissues consequent on instability of the diseased intervertebral joint.

Intraspinal herniation of the disk is a late complication of disk degeneration. When it occurs, an attack of lumbago or sciatica may result. There is a sudden spontaneous attack of low-back pain, probably when the disk tissue is in the process of protruding, with relief when the disk returns to its normal position or when the protrusion is completed. The sciatic symptoms are directly related to the specific nerves which are stretched by the protruding disk.

The most useful clinical test to determine whether an intraspinal lesion is present is straight leg raising. Routine radiography of the spine may provide evidence of pathological change in the disk, but it does not necessarily give information related to the current symptoms. Myelography is 85 to 90 per cent accurate in localizing the level of the lesion. As a compensation for the small error involved, the procedure has the advantage of revealing previously unsuspected lesions. Myelography is indicated (1) when there is suspicion of an intraspinal lesion other than a disk herniation; (2) when disk protrusion is diagnosed but the clinical picture is not clear cut; (3) when protrusion above the level of the fourth-fifth disk is suspected; (4) if an interlaminar or hemilaminar operative approach is contemplated; (5) to exclude herniation of a disk when neurosis is the considered diagnosis. The author has experienced no untoward sequelae with myelography.

In cases where conservative management has been given a trial and failed, removal of the entire fifth lamina and as much of the fourth lamina as is necessary to visualize both sides of the fourth and fifth disks is the recommended operative procedure.

RICHARD F. MCCLURE, M.D.
Redondo Beach, Calif.

Recognition and Treatment of Cervical Spine Injuries. Jesse T. Nicholson and William S. Armour. S. Clin. North America **33**: 1571–1585, December 1953.

Dislocation of the cervical spine with or without fracture demands primary consideration in cervical spine injuries. It usually results from trauma but may occur spontaneously.

Without moving the head, direct lateral and anteroposterior roentgenograms are obtained. If no displacement or rotation is detected, these views are supplemented by: (1) an open-mouth projection to demonstrate a fracture of the odontoid or atlas, (2) oblique views (for fractures of pedicles or laminae), and (3) a

submentovertical projection (for an arch fracture of the atlas). If fracture and dislocation are excluded, extension and flexion views may demonstrate subluxation.

Dislocation may involve one or both articular processes, the inferior process being displaced forward of the superior articular process of the subjacent vertebra. This is obvious on the lateral view if the dislocation is bilateral, but with unilateral jumped articular processes the lateral view may be inconclusive. The anteroposterior view will show a rotational deformity at the level of the dislocation.

Fracture-dislocations cause cord involvement by a number of mechanisms: (1) fracture of pedicles with direct impingement on cord or pressure by posterior dislocation of a suprajacent vertebra; (2) compression fractures of vertebral bodies with rupture of the posterior ligaments; (3) fracture of the odontoid and dislocation of the atlas; (4) depressed fractures of spinous processes and laminae.

Spontaneous dislocations follow upper respiratory infections, rheumatoid spondylitis, and poliomyelitis, and are usually seen in children. The hyperemia causes loss of ligamentous attachment, swelling of joints, and relaxation of ligaments. Dislocations occur between the first, second, and third cervical vertebrae.

Subluxation is a forward or lateral displacement of one vertebra upon the subjacent vertebra. It is an incomplete dislocation resulting from traumatic tearing or stretching of ligaments, occasionally with a mild compression fracture of a vertebral body. "Whip-lash" injury of the neck is the most common trauma. The site is usually between the fourth and fifth or fifth and sixth vertebrae. Lateral roentgenograms show loss of cervical lordosis. Views with the neck in maximum flexion reveal forward slipping, while extension views show reduction of the subluxation.

The symptomatology and treatment of these disorders are well presented.

Nineteen roentgenograms; 1 drawing.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Recognition and Treatment of Hip Dysplasia in the Infant. Paul C. Colonna. S. Clin. North America **33:** 1633–1641, December 1953.

Congential hip dysplasia (dislocation and subluxation) should be diagnosed clinically and roentgenographically in the first months of life. The prognosis is excellent if the limbs are gradually stretched into abduction, externally rotated, and held by splint or brace until there is roentgen evidence of a deep, secure acetabulum (usually eighteen to twenty-four months).

Roentgen examination confirms the clinical diagnosis by demonstration of delayed development of the capital femoral epiphysis (visible before the third month normally), upward displacement of the neck of the femur (failure to match with Shenton's line), and increased obliquity of the acetabulum (an angle of more than 25° is abnormal).

Twenty-one roentgenograms; 6 photographs.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

A Diagnostic Roentgen View of the Acetabulum. Paul C. Colonna. S. Clin. North America **33:** 1565–1569, December 1953.

An oblique view has been found to give more information about the depth and slope of the acetabulum than conventional views. The joint space and articular surfaces are more completely outlined. A tender, stiff, or swollen joint can be examined more easily in this manner, and surgical reconstructions are more readily evaluated. The patient is positioned with the unaffected hip against the table and the body is tilted forward at about a 17° angle to separate the joints.

The method has proved useful in osteoarthritis of the hip, for preoperative and postoperative films in congenital subluxation and dislocation, in early hip disease with progressive narrowing of the joint space, and in fracture-dislocations in which the femoral head is displaced owing to the fracture and displaced lip of the acetabulum.

Six roentgenograms; 1 drawings.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Chondrosarcoma of the Ilium Simulating Low Grade Osteomyelitis. John R. Moore. S. Clin. North America **33:** 1681–1691, December 1953.

Two cases of chondrosarcoma of the ilium simulating osteomyelitis are recorded. Errors in clinical evaluation, biopsy sites, microscopic interpretation, and roentgenographic impression led to late diagnosis. The author believes that the pathologists and radiologists were misled by the clinical history and that their conclusions would have been more accurate if they had been formed independently.

Five roentgenograms; 3 photomicrographs.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Anatomical and Radiological Studies Disproving the Existence of Osgood-Schlatter Disease. Manlio Franchi. Radiol. med. (Milan) **39:** 1181–1200, December 1953. (In Italian)

A good deal of controversy exists concerning the pathogenesis of idiopathic aseptic necrosis of the tibial tubercle. That ischemia plays an important role is suggested by the fact that the affected portion of the bone is surrounded by cartilage and under normal conditions receives a limited vascular supply. The author investigated the problems of etiology and pathogenesis and reached some rather challenging conclusions.

For about twenty-four months he studied the process of ossification of the two nuclei of the tibial tuberosity in 30 normal subjects of both sexes, ten to fifteen years old, with serial roentgenograms. The histology of the tibial tubercle and of the patellar ligament during the various stages of development and before the appearance of the ossification centers of the nuclei was also investigated by the serial method in boys of twelve to thirteen years. None of the subjects had previously presented signs or symptoms referable to the knee joint.

The author believes that the main nucleus of the tibial tuberosity is not of endochondral but of connective-tissue origin and that the presence of osseous nodules in the patellar ligament is a normal anatomic feature and not a pathologic condition. It was shown, furthermore, that ossification may extend above the point of union of the two nuclei of the tibial tuberosity and may be present and persist inside the patellar ligament. The author does not think that a true juvenile osteodystrophy of the main nucleus exists, though this condition can be observed in the cuneiform nucleus, which is

endochondral in origin. In such a case alteration of the growing cartilage can be demonstrated histologically and by x-ray examination. On the other hand, the development of the main nucleus is unaffected by diseases of the cartilage and is strictly dependent upon the anatomical and functional integrity of the patellar ligament.

Sixteen roentgenogram; 9 photomicrographs.

R. G. OLIVETTI, M.D.
Newington, Conn.

Dupuytren's Contracture. A Radiotherapeutic Approach. R. Finney. Lancet **2**: 1064–1066, Nov. 21, 1953.

The author reports his results with radium therapy in 25 cases of Dupuytren's contracture. The clinical condition in these cases was staged according to a modification of the lines advocated by Shaw (Brit. J. Plas. Surg. **4**: 218, 1951) as follows:

Stage I includes (a) hands with a nodule in the palmar fascia not yet including the skin and causing no contracture of the fingers or (b) nodules present in the skin with no apparent changes in the palmar fascia (3 cases).

Stage II comprises a nodule in the fascia involving the skin but not causing a finger flexion deformity (4 cases).

Stage III comprises a nodule in the palm invading the skin plus flexion contracture of one or more fingers (18 cases).

Stage IV includes all Stage III cases in which secondary changes have occurred in the tendons or joints of one or more fingers.

Gamma irradiation alone was used in the present series. As the pathologic changes may extend throughout the whole of the aponeurotic area, the tendency has been to irradiate the whole of this volume of tissue, comprising the palmar fascia and adjacent tissues. Two technics were employed according to the stage of the condition. In Stages I and II before contracture had occurred, a planar mold was made of Black Tray compound, and the area to be irradiated was mapped out on the mold. A treating distance of 1.0 or 1.5 cm. was used. In Stages III and IV, when contracture was present and a planar mold could no longer be applied, a grip cylinder was made, again of Back Tray compound, of a radius of 1.0 or 1.5 cm. A total dose of 3,000 r to the skin was given in fractional doses of eight hours a day for eight days. In no case did the patient have difficulty in wearing or retaining the appliance. Apart from some skin dryness and occasional slight erythema, no skin reaction was observed.

Subjective improvement, including softening of the nodules, lessening of paresthesia, and increase in finger movement, was evident within the first four weeks after treatment. Objective improvement, gauged by increase in movement, began on an average within 1.7 months and became maximal by six months. There was no improvement after twelve months had elapsed from the time of treatment.

The follow-up period was two to ten years. Of the 25 cases 75 per cent were improved and 25 per cent remained static. Of the patients who improved, 25 per cent fully recovered, 25 per cent partially recovered, and 25 per cent were only slightly improved. In no instance was the condition made worse or did the contracture increase after the treatment had been given. Those cases in which full recovery occurred belonged to Stage I or II, *i.e.*, before fibrosis or scar tissue had been laid down.

Recurrence following adequate irradiation of the palm appears to be rare, if it occurs at all.

The author believes that the logical approach to the treatment of Dupuytren's contracture is radiotherapy either alone or as a preoperative measure. If a combined attack be decided on, the functional improvement is allowed to continue until the greatest effect has resulted. After this, if functional disability remains, this may be corrected by surgical means. Postoperative recurrence will thus be reduced to a minimum.

Six illustrations; 1 table.

Fractures of the Ankle: V. Pronation-Dorsiflexion Fracture. N. Lauge-Hansen. Arch. Surg. **67**: 813–820, 1953.

In the fifth of a series of papers (see Absts. in Radiology **52**: 297, 1949; **56**: 781, 1951; **60**: 466, 1953), the author reviews the mechanism, radiographic appearance, and method of treatment of pronation-dorsiflexion fracture of the ankle. This type of fracture is invariably caused by a fall from a considerable height which causes forceful pronation and dorsiflexion of the foot. This type of fracture, according to the author, may occur in four stages: (1) a fracture through the base of the medial malleolus; (2) avulsion of a large fragment from the anterior lip of the distal tibia; (3) fracture of the supramalleolar portion of the lower fibula; (4) a transverse fracture of the dorsal aspect of the tibia several centimeters above the ankle joint. Thus, if Stage IV is reached, the fracture involves both bones of the leg, with a comminuted intra-articular fracture of the distal end of the tibia. The mechanism is demonstrated by drawings of an autopsy specimen obtained twelve days after occurrence of the fracture.

The author stresses the importance of rather prolonged immobilization *without weight-bearing* (about fifteen weeks), since this type of fracture heals more slowly than the usual fracture at the ankle. Reduction of the displaced fragments in Stage II and III fractures is accomplished by direct pressure against the large anterior tibial fragment, with the foot plantar-flexed and supinated and with simultaneous pull on the heel distally and dorsally. In the Stage IV fracture continuous traction by wire through the calcaneus incorporated in the plaster cast must be carried out in addition to the above. Immobilization is maintained for from four to six weeks with the foot in plantar flexion, following which a new cast may be applied in a mid-position between dorsiflexion and plantar-flexion, with no weight-bearing allowed.

Twenty-one roentgenograms; 2 drawings.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Epiphyseal Injury at the Ankle Joint. Edgar L. Ralston. S. Clin. North America **33**: 1611–1621, December 1953.

Twelve cases of injury to the distal tibial or fibular epiphysis are analyzed. Such injuries are most commonly the result of indirect violence with the foot fixed.

The most frequent injury is epiphyseal separation with a fracture of the diaphysis. This injury has a good prognosis. On the other hand, fractures of the epiphysis itself, extending across the cartilage plate and involving the active cartilage cells, result in growth disturbance at the ankle, usually osseous union at the medial tibial plate. This is inherent in the injury and no form of treatment will avoid it.

Roentgenographically, all of the author's patients showed either displacement of the epiphysis with a piece of the metaphysis or a fracture across the epiphysis. In some cases, however, clinical evidence of epiphyseal injury is present without significant roentgen findings.

Development of deformity demands operative correction. A variety of somewhat similar procedures have been suggested in the past, and the preference for any one of these may vary with certain features of the individual case.

Six roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Congenital Anomalies, Accessory Bones, and Osteochondritis in the Feet of 850 Children. Alfred R. Shands, Jr., and Irl J. Wentz. S. Clin. North America **33:** 1643–1666, December 1953.

Roentgenologic findings in the feet of 850 symptomatic children are presented; 27 per cent of these were significant. The most informative groups were: (1) spastic or rigid flatfoot, (2) accessory bones, (3) congenital anomalies, (4) osteochondritis.

The spastic or rigid flatfoot group consisted of 11 patients with calcaneonavicular bars, talocalcaneal bridges, and spurred talonavicular joints.

Statistics are given on the location of 115 accessory bones in 59 patients, the accessory scaphoid being the most common.

Congenital anomalies, observed in 44 children, consisted of amputations, polydactylism, syndactylism, and fusions (5 of two or more tarsal bones).

Of 13 osteochondritides, only 2 were a true Köhler's disease. Other bones involved were: accessory scaphoid, calcaneus, first cuneiform, first metatarsal, and medial malleolus.

Twenty-four roentgenograms; 6 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

GYNECOLOGY AND OBSTETRICS

Study of the Supportive Structures of the Uterus by Levator Myography. H. Berglas and I. C. Rubin. Surg., Gynec. & Obst. **97:** 677–692, December 1953.

A study was undertaken to determine the anatomic and functional relationship of the uterus to the levator ani muscle in the living subject under normal conditions and in cases of prolapse. The levator ani is the broad muscle which is attached to the inner surface of the side of the true pelvis. It unites with the muscle of the opposite side to form the diaphragm of the pelvic outlet. These muscles constitute a structural and functional entity which is composed of a plate filling the space between the coccyx and the anal portion of the rectum, and two crura forming the boundaries of the levator hiatus, which is pierced by the urethra, vagina, and rectum.

The authors visualize the levator ani muscle in the living subject by injecting an opaque substance into the muscle via the vaginal wall and contiguous structures. They believe that this is the first attempt to visualize muscles in such a fashion. Seventy-three patients were investigated, and in every instance it was possible to locate the crura and plate of the levator ani muscle and to leave a deposit of the contrast material in the muscle.

Under normal conditions, with intact muscular pelvic diaphragm, the levator plate has an almost horizontal course. The long axis of the vagina is more or less parallel to the levator plate. This is contrary to the steep oblique course of the long axis of the vagina commonly presented in the anatomic and gynecologic textbooks. The major portion of the vagina and the uterus are situated over the levator plate. With increased intra-abdominal pressure, the normal uterus is forced backward and downward against the levator plate, which provides it with adequate support and prevents prolapse.

In the defective muscular pelvic diaphragm, whether due to birth injury or other structural or functional impairment, the levator plate assumes a more vertical position. This results in an altered relationship of the uterus to the levator plate and in an increase in the longitudinal diameter of the pelvic floor aperture. Increase of the transverse diameter of the hiatus is due to impairment of the levator crura. This disturbed relationship is responsible for loss of support, and with increased intra-abdominal pressure, the uterus and vagina are permitted a forward direction toward the pelvic hiatus, with consequent prolapse.

The authors' contention that the long axis of the vagina is almost horizontal is not borne out by their roentgenograms, which indicate that the direction is more nearly at a 45° angle with the horizontal. It is still, however, more horizontal than was previously thought. The roentgen myograms are of a technical quality sufficient to give much information about the shape, length, and direction of the muscles, and it is to be expected that the method will be useful in other areas.

Roentgen myography may eventually demonstrate biologic properties of muscles and attain a significant place in the study of muscle physiology and muscle pathology.

Twenty-five myograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

The Position of the Foetus in Relation to Placental Site. A. S. Whitehead. J. Obst. & Gynaec. Brit. Emp. **60:** 854–858, December 1953.

The position of the placenta in 500 women at or after the thirty-fourth week of pregnancy was determined by soft-tissue placentography. In cephalic presentations the placenta is usually implanted on the anterior or posterior wall of the upper uterine segment of the uterus. The fundus and lateral walls are much less often the site of implantation.

In cases of transverse or oblique lie the placenta is most frequently situated in the fundus, in the lower uterine segment, or on the anterior wall of the upper uterine segment. It is usually found on the posterior wall of the upper uterine segment.

In breech presentations there is a high proportion (almost 50 per cent) of cornual implantation, which appears to favor persistence of the breech presentation. Cornual implantation, however, is not the sole cause of breech presentation, which may persist irrespective of the position of the placenta; other factors such as the attitude of the fetus and the shape of the uterus presumably operate in such cases.

Six roentgenograms; 8 tables.

THEODORE E. KEATS, M.D.
University of California

The Minor Degree of Hydrocephalus as an Obstetrical Problem. T. Francis Redman and G. R. Airth. J. Obst. & Gynaec. Brit. Emp. **60**: 888–891, December 1953.

The minor degree of hydrocephalus as an obstetrical problem is discussed and three case histories are presented, each illustrating some aspect of the problem. The first case was one of hydrocephaly with no widening of cranial sutures during labor without perforation. In the second the hydrocephaly was of such minor degree that the diagnosis could not be made with certainty before delivery. In the third, a hydrocephalic infant was delivered normally without perforation.

The authors suggest that closed sutures in the presence of hydrocephalus can be explained as a result of compression during labor, particularly if there is a meningocele to act as a reservoir.

Minor degrees of hydrocephalus can best be diagnosed by accurate and skilled cephalometry. An additional contributing sign is clinical cephalopelvic disproportion, with a very high head which cannot be pushed down despite a normal-sized pelvic brim. Widely diluted sutures noted by vaginal examination constitute, of course, the *sine qua non* in the diagnosis, but may not always be present.

In the management of a case of minor hydrocephalus, if doubt in the diagnosis exists, labor should be allowed to proceed. If the obstetrical situation calls for cesarean section, this must be performed as for a normal child unless the diagnosis of fetal abnormality is certain.

THEODORE E. KEATS, M.D.
University of California

A Plan for Radiography in Obstetrics. J. Blair Hartley and Miss A. Stirling Fisher. Published by St. Mary's Hospitals Management Committee, St. Mary's Hospitals, Manchester 13, England, 1954.

A method or routine for obstetrical radiography facilitates both examination and interpretation. A brief history, external pelvic measurements, and instructions to the patient are the first steps.

In the plan outlined in this monograph, as used in St. Mary's Hospital for Women and Children, Manchester, England, an anteroposterior supine view is first taken and checked, after which, depending on the findings and information desired (fetal age, placental site, measurements), lateral, prone, and oblique films are obtained. Proper positioning and technic can produce extremely informative films. The authors believe low-kilovoltage technics afford the best demonstration of fetal structures and placental site. Postero-anterior and anteroposterior films are most informative as to placental calcification and estimation of fetal age. An outlet view determines the "waste space of Morris" or adequacy of the subpubic arch.

The guiding principle of the technic is the use of the lowest kilovoltage possible, with 200–300 ma. and the shortest possible exposure. Accurate coning and firm compression are of utmost importance.

Since film and table top bear a constant relationship to the patient and each other, pelvic heights above the table determine the degree of magnification. Exposing a steel rule at various distances above the table and combining the results in a chart afford a scale by which pelvic measurements are readily corrected without mathematical calculation and possible errors. Anteroposterior diameters of the pelvis lie at a distance from the table top equal to half the trans-trochanteric diameter. The transverse and intraspinous diameters, with the patient supine, lie at two-thirds and one-third, respectively, of the vertical distance from the table top to the uppermost edge of the pubis.

Radiologic estimation of fetal bone age and maturity should be correct to within two weeks in most cases, and with close observation fetal weights can be predicted accurately. Placental calcification does not appear before thirty-two weeks but is present in almost one-third of cases and occasionally is helpful in diagnosis of placenta praevia.

Fourteen illustrations; numerous tables.

THE GENITOURINARY SYSTEM

Pyelography in Combination with Simultaneous Retroperitoneal Pneumography. John Duff, Herbert R. Kenyon, and Richard M. Hyman. J. Urol. **70**: 963–968, December 1953.

The authors have used intravenous or retrograde pyelography combined with pneumoretroperitoneum *via* the retrorectal space in the examination of 150 patients. After the introduction of 1,250 c.c. of oxygen (in the average patient) a film is exposed and, if the pneumogram is satisfactory, retrograde or intravenous urography, preferably the former, is performed. No serious discomfort was experienced by any patient. Renal, adrenal, and retroperitoneal masses were usually well outlined. Failure of gas to outline a kidney could be attributed to congenital defects, inflammation, previous surgery, or neoplastic infiltration of the perinephric tissues.

Eight roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

The Dorsal Cystogram or "Squat Shot": A Technique for Roentgenography of Posterior Bladder and Pelvic Ureters. William H. Boyce, James A. Harris, and Samuel A. Vest. J. Urol. **70**: 969–974, December 1953.

The single dorsal cystogram or "squat shot" has been found to be the best means of demonstrating ureteral reflux, bladder diverticula, and bladder or uterine tumors roentgenographically. The bladder is filled with 250 c.c. of 15 per cent sodium iodide in the usual manner. The patient sits upright on the cystoscopic table and dangles his legs. He then leans forward as far as possible, grasping his ankles. This centers the bladder over the Bucky tray and cassette, and a dorsal-caudal exposure is made. If any pathologic deformity is observed, routine anteroposterior, oblique and lateral exposures may then be made as indicated, though in the authors' experience these seldom provided additional information of clinical value.

Twenty roentgenograms; 1 drawing.

RICHARD E. BUENGER, M.D
Chicago, Ill.

A Safe, Simple Method of Performing Urethrograms. A. Estin Comarr and Lambert Dodenhoff. J. Urol. **70**: 980–981, December 1953.

Good quality urethrograms without exposure to the technician are obtained by injecting the urethra with contrast material and then clamping the penis with a Cunningham clamp. A wire hooked onto the clamp extends over the table to a weighted bag thus maintain-

ing the penis in the proper position for the roentgenogram.

One photograph; 1 drawing.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Circulatory Collapse Following Combined Use of Rayopake and Air for Urethrocystography. Kenneth A. Forbes and Justin J. Cordonnier. J. Urol. **70**: 975–979, December 1953.

A case is reported in which the combined use of air and Rayopake for urethrocystography resulted in a near-fatal shock-like reaction. The patient had a vesicosigmoid fistula and a congenital anterior urethral membrane. It is speculated that the force of the injection to overcome the urethral obstruction may have been a factor in precipitating the reaction either by increasing the absorption rate of the iodine compound or by forcing air into the veins of the inflammatory mass (vesicosigmoidal fistula) in the bladder.

Introduction of air into the bladder or urethra for any reason is not recommended, and injection of iodine-containing material should be done with caution when an obstruction is encountered.

Two roentgenograms; 2 drawings.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Nonopaque Urinary Tract Calculi. Charles C. Higgins. J. Urol. **70**: 857–863, December 1953.

True non-opaque urinary tract calculi are infrequently found. Most *renal calculi* contain enough calcium to be of relatively increased density. For their demonstration a soft-tissue technic is usually advisable, as this will bring out the difference in density between stones of low opacity and the kidneys and surrounding tissues. Failure of visualization may be due to confusing fecal and gas shadows, lack of immobilization, improper radiographic factors, an unusual location of the kidney, location of the calculus over a bony area, or very small size.

The visibility of *ureteral calculi* is also influenced by extraneous factors, as well as by their chemical composition. In only 4 per cent of the author's last 500 consecutive cases of ureteral calculi was there failure to cast a shadow or was the stone overlooked on the roentgenogram.

Vesical calculi are frequently phosphatic in type and, having the same relative opacity as the soft tissues in the body, are not visible roentgenologically. Also the shadow cast by the calculus may overlie the sacrum and thus be obscured, or fecal contents in an inadequately prepared patient may prevent its recognition. For these reasons a cystoscopic survey is advisable when vesical calculus is suspected.

Seven roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

The Diagnosis of Prostatic Calculi with Special Reference to the Therapeutic Result. G. H. Kötzschke and E. Schumann. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 733–738, December 1953. (In German)

Calculi are visualized within the region of the prostate more commonly than is indicated by the earlier literature. They are classified as of primary or secondary origin. Primary stones originate in the prostate from the corpora amylacea and increase in size by addition of inorganic salts. Secondary stones may be formed originally in the bladder, kidney, ureter, etc., whence they enter the prostatic ducts and are carried by the urine to the prostatic urethra, where they are enlarged by the addition of urinary salts. A third type of calculus, formed in a diverticulum within the prostatic urethra or the remnant of the müllerian duct, has also been suggested. The etiological background is frequently chronic prostatitis, especially in association with hypertrophy, gonorrhea, tuberculosis, or trauma. Clinical symptoms are tenesmus, pain, hemospermia, incontinence, urinary retention, and hematuria. Abscesses and fistulas may occur in long-standing cases.

X-ray investigation includes plain film studies, preferably angled to throw the sacrum and coccyx off the prostatic area, intravenous pyelography, and urethrography. By such means the size and location of the stones may be determined, as well as related inflammatory conditions of the bladder, the size of the prostatic lobes, and the condition of the posterior urethra, including possible abscess and fistula formation. The x-ray studies directly guide the surgeon in operative intervention.

Three cases are reported.

Seven roentgenograms; 1 photograph.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Ureteropelvic Obstruction with Hydronephrosis: Treatment by Pyeloplasty in 23 Cases. Charles N. Burns, J. Edwin Drew, and Archie L. Dean. J. Urol. **70**: 846–856, December 1953.

The authors summarize their experience in the surgical treatment of 23 ureteropelvic junction obstructions. The proper selection of patients for conservative operation depends on the accurate diagnosis of a persistent organic obstruction sufficient to cause progressive hydronephrosis in a kidney which retains adequate function to sustain life and which is not affected by some other disease requiring nephrectomy. These factors can ordinarily be determined by (1) excretory and/or retrograde pyelography, which visualizes the characteristic deformity of pyelectasis and caliectasis proximal to an area of obstruction located at the ureteropelvic juncture; (2) promptness of appearance and the concentration of the contrast medium on excretory pyelography; (3) the thickness of parenchyma visualized on the pyelogram; (4) the delay in emptying or pelvic retention shown by a "trapping film" taken ten minutes after retrograde injection of contrast medium. Occasionally more searching tests are required to substantiate suggestive findings.

The type of obstruction most frequently encountered in this series was congenital stenosis. In several instances this existed in association with aberrant vessels, bands, adhesions, kinks, or ptosis. Correction of these extrinsic factors was followed by pyeloplasty if a 12F catheter then failed to pass the obstruction. Resection and ureteropelvic anastomosis, the Foley Y-V type of repair, and intubated ureterotomy were the surgical procedures employed. The urinary stream was diverted and redundant pelves were resected. Nineteen cases showed pyelographic improvement.

Fifteen roentgenograms; 9 tables.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Pheochromocytoma Before and After Surgery. Report of a Case with Pharmacologic Tests, Roentgenologic Diagnosis, and Endocrine Survey. Eugene B. Levin. Arch. Int. Med. **92**: 906–919, December 1953.

The case is presented of a 33-year-old white man who had a pheochromocytoma that was removed surgically. The patient complained of recurrent attacks of profuse sweating, nervousness, tremor, headaches, and a tight sensation in the chest over a period of three or four years. Eight years earlier he had been told that he had high blood pressure. He also noted flickering spots before his eyes, dyspnea, precordial pain, marked salivation followed by thirst, and syncope.

The physical examination revealed an elevated blood pressure that varied from time to time. The pharmacologic tests were consistent with the diagnosis of pheochromocytoma. Extraperitoneal pneumography was performed three times, showing a 6 × 6-cm. mass above the superior pole of the right kidney. This mass was also demonstrated by intravenous pyelography, planigraphy, and aortography. At surgery an orange-size tumor was found just above the right kidney.

The author discusses the metabolic effects of epinephrine and the clinical pictures of thyrotoxicosis and diabetes in cases of pheochromocytoma.

One roentgenogram; 1 photomicrograph; 6 graphs.

HOWARD L. STEINBACH, M.D.
University of California

MISCELLANEOUS

The Radiology of Soft Tissue. A Preliminary Consideration of Basic Principles. L. Drey. Brit. J. Radiol. **26**: 619–627, December 1953.

If due regard is had for the normal configuration and distribution of fat in the subcutaneous and deeper layers of the soft-tissue elements of the body, soft-tissue radiography may be of considerable help in the differentiation of various pathologic processes.

Soft-tissue structures generally fall, in terms of density, into two groups: one which embraces the substances whose density approximates water (fibrous tissue, cartilage and muscle tissue, fluid constituents of the blood and lymph) and one in which the cellular content is chiefly fat. The normal subcutaneous fat reveals itself on the roentgenogram as a homogeneous shadow broken by a reticulum of fibrous septa, lymph channels, and blood vessels. More deeply, in regions occupied by muscle tissue, the homogeneous shadow of the latter is interspersed by bands of diminished density representing the presence of fat in the intermuscular planes. Technical factors will vary from region to region, but it is generally not difficult to adjust the kilovoltage to demonstrate clearly these contrasting substances.

Most morbid processes in the soft tissues influence the content of water or fat and, therefore, the form of the boundary zones as they appear on the x-ray film. Certain pathological processes are associated with well defined alterations in the patterns so produced, and a detailed consideration of these patterns forms the basis of the author's discussion. For convenience, the various soft-tissue changes are divided into the following groups: (1) increase of aqueous substance in the subcutis, including (*a*) encroachment of aqueous material in the form of fluid into the subcutaneous tissue, (*b*) proliferation of fibrous tissue, and (*c*) encroachment of pathological blood and lymphatic vessels into the subcutis; (2) increase of aqueous substance in the musculature (intermuscular edema; intramuscular edema); (3) increase of fatty substance in the subcutis, as in (*a*) normal adiposity and (*b*) local fatty deposits (lipoma; oleoma); (4) increase of fatty substance in the musculature.

Seventeen roentgenograms.

Generalized Calcinosis in a Case of Primary Lymphosarcoma of Retroperitoneal Lymph Glands. J. L. Donhauser. Arch. Surg. **67**: 927–930, December 1953.

A case of generalized calcinosis and multiple destructive bone lesions associated with retroperitoneal lymphosarcoma is presented. According to the author, malignant neoplasms are rarely associated with generalized calcinosis. He was unable to find any specific examples in the literature.

The patient was a 9-year-old white male with a three weeks history of pains in the thighs and upper right arm and fever of 100 to 101°F. daily. A tender hard mass was present along the proximal right humerus, and there was a slight tenderness on palpation of the upper third of the right femur. The significant laboratory findings were a serum calcium of 14.9 mg. per 100 c.c., phosphate 2.02 mg. per 100 c.c., and an alkaline phosphatase of 3.8 Bodansky units. There was a slight normochromic anemia with a normal white cell count.

Roentgenograms showed localized destructive lesions in the shaft of the right humerus extending 7 cm. distal to the proximal epiphyseal line. Similar lesions were present in the right scapula, the distal ends of both femora in the submetaphyseal region, and in the proximal ends of both tibiae close to the epiphyseal lines. A destructive lesion was also present in the right fibula. There was patchy demineralization involving the skull, sacrum, both ilia, the superior and inferior pubic rami on both sides, and the region of the greater trochanters of both femora. Destructive lesions were present in the thoracic and lumbar vertebrae. The ribs were decalcified.

A biopsy of the right humerus was reported as showing bone fragments undergoing absorption, with lymphocytes, eosinophils, and giant cells present in the marrow. Pathologically the lesion was considered to be either osteitis fibrosa cystica or Hand-Schüller-Christian disease.

There was a rapid increase in pain and tenderness over the shafts of the femora and humeri, firm subcutaneous nodules appeared all over the body, and a generalized lymphadenopathy developed. Repeat roentgenograms showed, in addition to the earlier changes, pathologic fractures of the left superior pubic ramus and of the right femur at the level of the lesser trochanter and destructive lesions in the radii and ulnae and phalanges of both hands and feet. Calcification of the soft tissues became visible.

Autopsy revealed diffuse soft-tissue nodules of calcification and extensive calcium deposition in the abdominal muscles, lung parenchyma, and subintimal tissue of blood vessels. A retroperitoneal lymphosarcoma was found, invading most of the internal organs.

The etiologic factor responsible for the generalized calcinosis in this case remains undetermined. The possibility of an aberrant parathyroid was considered but none was found in spite of a meticulous search.

DONALD OTTO, M.D.
Detroit, Mich.

The Roentgen Aspects of the Congenital Anomalies in the Umbilical Region. Robert M. Lowman, Levin L. Waters, and Howard W. Stanley. Am. J. Roentgenol. **70:** 883–910, December 1953.

The authors present a full account of the embryologic development of the omphalomesenteric duct and the allantois. The relations of these structures to the umbilical area are described in detail, with many drawings of the human embryo in various stages of development.

The following classification of malformations involving the umbilical area, by Trimingham (Surg., Gynec. & Obst. **80:** 152, 1945) is employed:

I. Alimentary anomalies
   - A. Completely patent omphalomesenteric duct (umbilical enteric fistula).
   - B. Partially patent omphalomesenteric duct.
     1. Peripheral portion (umbilical sinus).
     2. Intermediate portion (vitelline cyst).
     3. Enteric portion (Meckel's diverticulum).
   - C. Mucosal remnant of the umbilicus (umbilical polyp).
   - D. Congenital band (obliterated omphalomesenteric duct).

II. Urachal anomalies.
   - A. Completely patent urachus (umbilical urinary fistula).
   - B. Partially patent urachus.
     1. Peripheral portion (umbilical urachal sinus).
     2. Intermediate portion (urachal cyst).
     3. Vesical portion opening into the bladder.

III. Vascular anomalies.
   - A. Persistent omphalomesenteric vessels.
   - B. Persistent umbilical vessels.
   - C. Persistent urachal vessels.

IV. Somatic Anomalies.
   - A. Congenital umbilical hernia.
   - B. Extrophy of the bladder.
   - C. Endometriosis of the umbilicus.

The rarest anomaly is the completely patent omphalomesenteric duct, which represents a true fistula between the bowel and the umbilicus. This defect occurs much more commonly in males than in females. Frequently it is associated with other congenital abnormalities of the various organ systems. Clinically, at birth, there is usually noted some drainage and a reddish mass in the umbilical region following the sloughing of the cord. Far advanced cases show actual tumor-like extension in the area. The drainage is alkaline and causes excoriation of the surrounding skin. Probing is to be condemned; the introduction of radiopaque material with the use of a blunt-nosed nozzle has proved the most satisfactory method of determining the type of fistulous tract present. The length, caliber, and point of junction with the small bowel can thus be ascertained. It is almost impossible to demonstrate the fistulous connection following oral ingestion of opaque material.

The most serious complication of the umbilical fistula is a prolapse of the intestine through it. The authors describe the clinical manifestations and physical findings of this complication. Until recently the mortality of umbilical herniation has been very high.

The authors next discuss the umbilical sinus which forms when the peripheral portion of the omphalomesenteric duct fails to close. In this case, there is no intestinal drainage. If an intermediate segment of the duct fails to become obliterated, a vitelline cyst may result. This can be confused clinically with a mesenteric cyst. Vitelline cysts vary greatly in size and position and consequently in symptomatology.

To be distinguished from the omphalomesenteric duct is the patent urachus. A completely patent urachus communicates with the bladder and drains urine. The umbilicus may show little or no change from normal or there may actually be a large protruding mass. Blockage as a result of infection may produce an intermittent flow of urine because of involvement of the urachal canal. The mild irritation of the skin about the umbilicus associated with the escaping urine differs from the marked excoriation with a completely patent omphalomesentric duct. A partially patent urachus may also exist. In this event only a clear mucinous secretion is noted.

Urachal cysts, which occur when the intermediate portion of the urachus is patent, have been reported. These cystic masses must be distinguished from a distended bladder, ascites, ovarian cysts, and a localized peritonitis.

Detailed radiographic examination of the urinary tract is important in all cases of urachal abnormality. Again, the best method is the injection of the opaque material into the opening at the umbilicus and the tracing of the duct into the bladder area. The lateral film is of the greatest aid.

Four case reports are included, 2 of patent omphalomesenteric duct and 2 of patent urachus.

Fourteen roentgenograms; 2 photographs; 1 photomicrograph; 13 drawings.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Diffuse Systemic Angiomata. Francis E. Stock. Brit. J. Surg. **41:** 273–277, November 1953.

Diffuse systemic angiomata is the least well recognized of the angiomata. It is a tumor arising from malformation and proliferation of pre-existing vessels in muscle, bone, glands, and viscera, and is not considered a true neoplasm. It may well fit the classification of hamartoma. The same tumor may show capillaries, cavernous systems, and large venous spaces. Since these tumors do not communicate freely with the general circulatory system, they rarely show signs of increased blood flow such as warmth, pulsation, or bruit.

Sixteen cases are presented, of which only 2 were in patients over thirty years of age. The usual complaint is rapid increase in the size of a mass which has been present for a number of years.

Radiological evidence is occasionally of value in establishing the diagnosis. Soft-tissue films may show multiple phleboliths in the involved area. Occasionally, bone involvement may be demonstrated. Venography has been of value on occasion, but the tumor fills infrequently.

Surgery is the treatment of choice. Interstitial irradiation may be used for lesions which are not too extensive and yet are not practicable for excision.

Three roentgenograms; 3 photographs; 1 table.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

RADIOTHERAPY

Carcinoma of the Floor of the Mouth. Stanford Cade. Brit. J. Surg. **41**: 225–230, November 1953.

Carcinoma of the floor of the mouth is a clinical entity only in its early stages. Its mode of spread is in three directions: (1) to the intrinsic and extrinsic muscles of the tongue; (2) to the gum, with or without involvement of the alveolus; (3) to the cervical lymph nodes. The tumor is an epithelial cancer, varying in degree of keratinization and anaplasia. It occurs predominantly in men (80–85 per cent of cases). It must be differentiated from benign mucous and salivary gland tumors, acute monocytic leukemia, metastasis to the lower jaw from a clinically silent lesion on the tongue, and rhabdomyosarcoma.

The two modes of treatment are radiotherapy and surgical excision. The stage of the neoplasm dictates the treatment of choice:

1. Early localized lesion: Radiotherapy is the method of choice. When the disease is limited to the mucous membrane, interstitial radium alone is sufficient.
2. Localized spread to muscles: Radiotherapy is the treatment of choice. This may be by interstitial radium or by teleradium and should be followed by diathermy destruction of tissue. The tissue dose should be no less than 7,000 r; higher doses, 9,000 to 10,000 r, with risk of radionecrosis of the mandible, are justified if control of the disease can be achieved.
3. Extension to alveolar mucosa: Teleradium is the method of choice if the mandible is clinically and radiologically intact.
4. Involvement of mandible: Surgery is the treatment of choice.
5. Lymph node involvement: Surgery is the treatment of choice if the primary lesion is controlled. The necessity of bilateral neck dissection may arise if the tumor is near the mid-line. When the nodes are adherent or fixed, teleradium or supervoltage therapy may be used, although this is chiefly palliative.
6. Inoperability is indicated by involvement of the pharyngeal mucosa or pharyngeal part of the tongue, node fixed or adherent to the vascular sheath, edema of subcutaneous tissue, or gross involvement of soft tissue in the submental or submandibular area.

For 89 patients seen since 1925 and followed for five years the survival rate was 27 per cent. In early localized lesions, a five-year survival of 45 per cent was achieved by radium. Involvement of both floor of the mouth and tongue allowed only 17 per cent five-year survival; of floor of the mouth and jaw, 41 per cent; of floor and lymph node involvement, 15 per cent.

Eleven photographs; 1 drawing.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Carcinoma of the Floor of the Mouth. B. W. Windeyer. Brit. J. Surg. **41**: 231–237, November 1953.

One hundred and thirty-one cases of carcinoma of the floor of the mouth were seen at the Middlesex Hospital (London) between 1931 and 1946: 53 involving the floor of the mouth alone; 16 involving the lower alveolus alone; 62 involving both the floor of the mouth and alveolus. In 79 there was clinical cervical lymph node involvement. Grossly, the early case is most often an ulcerated lesion. Hypertrophic and nodular lesions are less common.

The diagnosis is usually established by biopsy. Traumatic ulceration due to ill-fitting dentures, osteomyelitis of the mandible, syphilis, and actinomycosis may cause some confusion.

Of the 131 cases in this series, 13 were too far advanced for any treatment; in 3 treatment of the primary lesion was by surgery; 115 primary lesions were treated by various radiotherapy technics. Lymph node metastases were treated by block dissection except those which were advanced. These received palliative irradiation.

The main method of treating the primary lesion was by a combination of intra-buccal radium applicator, teleradium, and when necessary, a vertical single plane radium implant across the mouth and posterior to the growth. The intra-buccal appliance holds radium needles at a fixed distance, usually 7 mm., from the surface of the growth. A 10-gm. teleradium unit is used to irradiate through the submental and submaxillary regions. Palliative therapy to involved lymph nodes is also given with teleradium. The tumor dose is usually 7,000 r given by the combined treatment.

The crude five-year survival rate, including untreated cases, is 26.7 per cent. The results are analyzed as follows:

	Without node involvement	With node involvement	Total
Floor of Mouth			
Cases	26	23	49
5 years recurrence-free	14 (54%)	4 (17%)	18 (36.7%)
Alveolus			
Cases	11	5	16
5 years recurrence-free	4	3	7 (44%)
Floor of Mouth and Alveolus			
Cases	13	37	50 (16%)
5 years recurrence-free	5 (38.9%)	3 (8%)	8
All Sites			
Cases	50	65	115
5 years recurrence-free	23 (46%)	10 (15.4%)	33 (28.7%)

The complications of radiotherapy in carcinoma of the floor of the mouth are hemorrhage from the ulcerated area, soft-tissue necrosis, and necrosis of bone. In 11 patients in this series some degree of necrosis developed in either soft tissue or bone. In 3 it was severe and disabling, but all are alive and free of recurrence more than ten years after treatment. Each of the 3 had radiologic evidence of invasion of the mandible.

Three roentgenograms; 13 photographs; 1 drawing; 2 graphs.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Carcinoma of the Floor of the Mouth. J. L. Dobbie. Brit. J. Surg. **41**: 250–253, November 1953.

The double mold of radium in the treatment of carcinoma of the mouth has several advantages. Not only is the radiation effect confined to the minimum necessary volume, but it is possible to include extensions of the tumor onto and into the jaw in the effective field of irradiation. Disease with lateral and forward extension lends itself to this form of treatment; sometimes extension backward into the tongue can be included if

the outer mold is replaced by a submental plane of implanted radium. Only about one-half of the cases, however, are suitable for radium molds. Implanted radium must be used for the other cases. Radon seeds are particularly applicable in aged patients and those with superficial lesions.

The advantage of these methods is that the primary site can be controlled without loss of tissue. In the event of failure, there is a second chance for surgery in appropriate cases. Lymph node involvement is handled by block dissection.

The author presents an analysis of a series of 345 cases treated at the Christie Hospital and Holt Radium Institute of Manchester, England. The evidence, as a whole, may be conveniently summarized as showing a cure-rate of about 60 per cent for early cases and for cases without secondary nodes, and 30 per cent for cases qualifying for block dissection, and also for the whole group of patients, including all ages and stages.

Four photographs; 8 drawings; 5 tables.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Results of Treatment for Cancer of the Larynx. Norman A. McCormick and John H. Maus. J. Canad. A. Radiologists **4**: 90–93, December 1953.

Cancer of the larynx may be treated by surgery or by radiation. For cancer of the intrinsic larynx involving only a single movable cord and not extending anteriorly to the commissure or posteriorly to the arytenoids, laryngofissure, hemilaryngectomy, or roentgen rays may be used. More advanced cases may be treated by irradiation or laryngectomy. Surgery is best for radioresistant cases and irradiation failures (usually due to poor treatment).

Cancer of the extrinsic larynx is treated by fractional irradiation. For metastases, radon or radium implantation is preferred to block dissection.

Five illustrative cases are reported and some of the hazards of radiation therapy are discussed.

PAUL MASSIK, M.D.
Quincy, Mass.

Carcinoma of the Thyroid in Childhood and Adolescence. Shields Warren, Mario Alvizouri, and Bentley P. Colcock. Cancer **6**: 1139–1146, November 1953.

This paper deals with 23 patients less than twenty years of age having carcinoma of the thyroid, representing 3.7 per cent of all thyroid carcinomas seen at the Lahey Clinic between 1928 and 1951, or about one per thousand operations on the thyroid. Thyroid carcinoma is more frequent in females, about 1.8 to 1.

Papillary adenocarcinoma is the most common type of thyroid cancer in children (47.7 per cent of all forms); the small-cell carcinoma is next in frequency (17.3 per cent).

In the great majority of cases, the first sign of the disease is the appearance of a nodule in the thyroid or in the lateral aspect of the neck. The most common mode of spread is metastasis to the anterior and posterior triangles on the same side of the neck. The second most common site of metastases is the lungs.

All nodular goiters, especially solitary nodules in children, should be removed as soon as they are discovered. If they are found to be malignant, the authors carry out a radical neck dissection, together with total removal of the thyroid lobe and isthmus of that side. Subsequently the patient receives external radiation therapy. With 200 kv., a maximal dose just short of wet desquamation is given. With sources having a half-value layer of 8 mm. copper or better, 4,800 r is delivered to the thyroid bed in twenty-eight days. The field extends from the lymph nodes at the angle of the maxilla down to the bifurcation of the trachea. In cases other than adenoma with blood-vessel invasion or adenocarcinoma of the follicular or papillary type, radical neck dissection is not done.

Two charts; 5 tables.

RICHARD E. OTTOMAN, M.D.
University of California, Los Angeles

X-Ray Therapy of Carcinoma of the Esophagus. Hans-Joachim Fiebelkorn and Eberhard Scherer. Strahlentherapie **92**: 383–394, 1953. (In German)

In spite of recent progress in thoracic surgery the treatment of carcinoma of the esophagus still remains largely in the hands of the radiologist. Only about 12 per cent of cases are suitable for radical surgery and there is still a high postoperative mortality, especially when the tumor is located in the upper or middle third of the esophagus. Nevertheless, before starting x-ray therapy, consultation with the surgeon is recommended, as all operable cases should undergo resection since only surgery can achieve a permanent cure.

Radiotherapy is considered only a palliative measure designed to make the last months of the patient as comfortable as possible. Prolongation of life is a secondary consideration and therefore the method which gives the best palliation and is easily tolerated should be selected.

The authors compare the results of three standard methods used in the treatment of inoperable carcinoma of the esophagus.

(1) The least favorable results were obtained with the customary roentgen therapy with patient and x-ray tube stationary, using multiple small portals and a tumor dose of 2,000 r up to 5,000 r.

(2) Combined intra-esophageal radium and external stationary x-ray therapy slightly improved the results statistically. This method, however, was applied in selected and therefore especially favorable cases, since the restitution of esophageal patency was a presupposition for the intra-esophageal radium therapy. This fact in itself improves the survival rate, as patients with disease frequently died in the interval between the preparatory x-ray treatment and planned radium therapy.

(3) The best results were obtained with rotation therapy, either with the patient rotating in a sitting position or the x-ray tube swinging like a pendulum, preferably under fluoroscopic observation and control. The authors recommend this as the method of choice. Two series are given, with a tumor dose of 3,000–5,000 r each, with an interval of three to four months.

Six roentgenograms; 2 photomicrographs; 5 graphs; 1 table.

HERBERT POLLACK, M.D.
Chicago, Ill.

Some Radiotherapeutic Aspects of Glandular Cutaneous Cancer. Kai Setälä. Am. J. Roentgenol. **70**: 991–1004, December 1953.

Thirty-three cases of glandular cutaneous cancer are reviewed. These tumors contain sebaceous and/or sudoriferous glands. Some, in their mode of growth and general course, resemble ordinary skin carcinomas. Others, constituting a smaller group, resemble certain carcinomas of the mammary glands.

Cancers of the first group were cured if treated with irradiation according to generally accepted principles. The second group, with properties similar to mammary cancer, were not cured. They tended to grow *en cuirasse*, spreading eventually to all organ systems.

Five case histories with clinical photographs, microscopic sections, and details of treatment are included.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Cathode Ray Treatment for Lymphomas Involving the Skin. Hugh F. Hare, John L. Fromer, John G. Trump, Kenneth A. Wright, and John H. Anson. Arch. Dermat. & Syph. **68**: 635–640, December 1953.

High-energy cathode rays are particularly suitable for the treatment of extensive superficial malignant lesions, provided the electrons are essentially monoenergetic and normally incident upon the skin. The clinical advantage of this form of therapy arises from the possibility of selecting the desired electron penetration by controlling the voltage, from the complete absence of damage to tissue beyond the well defined electron range, and from the reduced biological effect in the outer layers of radiosensitive skin.

Five patients suffering from lymphomas (mycosis fungoides) were given cathode-ray treatments to the entire body surface with virtually complete disappearance of the surface lesions and with no adverse effect on the skin or underlying tissue. The electrons were produced by a constant-potential accelerator of the Van de Graaff type and projected into air toward the skin of the patient as a directed stream of particles.

Three photographs; 2 drawings.

Combined Chemotherapy and Roentgen Therapy in Metastasizing Seminoma. Helmut Martin and Alfred Kaufmann. Strahlentherapie **92**: 402–411, 1953. (In German)

Because of lack of permanent improvement from irradiation in metastasizing seminoma, supplementary chemotherapy appeared indicated in an attempt to better the prognosis. The authors report 3 cases in which they obtained very satisfactory results, far surpassing the generally poor prognosis, by combining roentgen irradiation and treatment with choline esters and choline salts as well as sulfonamides. In all 3 cases metastases were present in an inoperable stage.

In the first patient, a fifty-three-year-old white male, a large retroperitoneal malignant tumor disappeared after roentgen therapy in combination with intravenous injections of sulfathiazole. Two years later semicastration was done for a seminoma of the left testis, which proved to be the responsible primary tumor. After six weeks a metastasis in the mediastinum was irradiated and a year and a half later metastatic deposits in the pelvis were treated by a combination of irradiation, sulfathiazole and the choline ester Doryl, leading to a complete involution of the tumors. The patient was free of disease and able to resume his normal occupation. He died six years after the first appearance of metastasis, as a result of a pulmonary embolism, following an accident. A very careful autopsy failed to show any evidence of living tumor cells, so that this case can be regarded as a cure of metastasizing seminoma.

The other 2 patients undergoing combined radiation and chemotherapy are still alive, after six and seven years, respectively, free of disease.

As, in the long run, the prognosis in metastasizing seminoma is very poor so far as exclusive roentgen irradiation is concerned, the combined treatment is considered to constitute a therapeutic advance.

Two photomicrographs.

HERBERT POLLACK, M.D.
Chicago, Ill.

Diagnosis and Treatment of Vertebral Hemangioma. Umberto Cocchi. Strahlentherapie **92**: 368–374, 1953. (In German)

Observations on 26 cases of vertebral hemangioma treated during the past twenty years at the Central Roentgen Institute of the University of Zurich are presented. Only 140 cases of hemangioma of bone have been previously reported. Hemangiomas of bone are benign, slow growing tumors which show either a cavernous or a capillary structure. They occur in all age groups and have been observed as early as twelve and a half years and as late as seventy-six years of age.

The x-ray picture is rather characteristic and usually does not give any diagnostic difficulty. However, as a result of subperiosteal hemorrhages, a paravertebral spindle-shaped shadow is frequently observed, which could be easily mistaken for a paravertebral abscess of tuberculous spondylitis. Metastatic vertebral lesions, plasmocytoma, and Paget's disease are also to be considered in the differential diagnosis.

Vertebral hemangiomas are usually rather small and do not require any treatment as long as they produce no symptoms. Otherwise surgery, irradiation therapy, or a combination of both methods is advisable.

The author reports the results of x-ray therapy alone and also of the combined surgical-radiological method in 19 patients. After treatment, approximately 60 per cent of the patients were free of symptoms and another 10 per cent showed improvement. The total dose was 4,000 to 6,000 r, and in a few cases as much as 7,200 r (in air).

The author concludes that x-ray therapy is the method of choice in vertebral hemangioma in the absence of vertebral compression. In cases with compression symptoms, decompression laminectomy should precede irradiation.

Two roentgenograms; 3 tables.

HERBERT POLLACK, M.D.
Chicago, Ill.

X-Ray Therapy of Arthritis Deformans. Günther von Pannewitz. Strahlentherapie **92**: 375–382, 1953. (In German)

X-ray therapy of arthritis deformans is a rather old and well established method which has nearly fallen into oblivion because of various newer procedures. The purpose of this paper is again to call attention to this mode of treatment. The results depend mainly on the dose and the interval between treatments. The author considers the usual dose of 150–200 r per treatment too high and recommends 50 r as optimal single dosage for articulations of the extremities and 100 r for the hip joints and the spine. The most favorable interval is one week, with a series of five to eight single treatments. Repetition of the series after two months and again after three more months considerably improves the permanent results.

The earlier in the course of arthritis deformans x-ray therapy is started, the better are the results. Allevia-

tion of pain was obtained in 85 per cent and considerable improvement and relief of pain in 60 per cent of the author's cases (2,555 joints). The favorable results are independent of age and roentgen findings and still prove to be superior to those obtained with other methods such as physiotherapy and drugs.

Three tables. HERBERT POLLACK, M.D.
Chicago, Ill.

Observations on Tubercular Lymphadenitis Treated with Deep X-ray: Report on 271 Cases. N. M. Banerjee. J. Indian M. A. **23:** 113–116, December 1953.

Two hundred and seventy-one patients with histologically proved tuberculous lymphadenitis without demonstrable pulmonary disease were treated with x-rays. The involved nodes were confined to a single area in 43 per cent of the series, usually the neck. The most common sites of multiple involvement were both sides of the neck, the neck and axilla, and the neck and mediastinum.

The clinical findings varied from acute and chronic febrile attacks with draining sinuses to enlarged nodes without constitutional symptoms. Pain was usually absent. The nodes were characteristically matted and adherent to the skin.

The author believes that all but about 10 per cent of the patients were benefited by irradiation. The nodes diminished in size, fever subsided, and sinuses healed in three to six months. There were some recurrences following treatment, and some patients required more than one course of therapy. The nodes were aspirated, if fluctuant, but no patient was allowed streptomycin or PAS during the course of x-ray therapy. The number of treatments, the dosage, and the treatment factors are not given.

Four tables. RICHARD E. BUENGER, M.D.
Chicago, Ill.

Isodose Curves for Intra-Cavity Roentgen Therapy. E. Dale Trout, John P. Kelley, and Arthur C. Lucas. J. Canad. Assoc. Radiologists **4:** 84–89, December 1953.

The development of small volume ionization chambers has made possible the determination of isodose curves for the small fields used in intracavity therapy. The curves presented here are for 140 kv.p. and 0.25 mm. copper filter, with a half-value layer of 0.5 mm. copper, and a standard target distance of 40 cm. Both Bakelite and metal cones were used. The former yield a larger field due to penetration of irradiation through the wall. The dose at the end of the speculum is the air dose. To this is added back-scatter, data for which are included.

Nine figures showing isodose curves; 1 table.
PAUL MASSIK, M.D.
Quincy, Mass.

Experience with the 30 MeV Synchrotron as a Radiotherapeutic Instrument. III. Approach to Clinical Use. J. S. Mitchell, C. L. Smith, D. J. Allen-Williams, and R. Braams. Acta radiol. **40:** 603–613, December 1953.

This is the third of a series of papers on the 30-mev synchrotron in the Radiotherapeutic Centre, Addenbrooke's Hospital, Cambridge, England. The first was concerned with technical aspects (Acta radiol. **40:** 419, 1953. Abst. in Radiology **63:** 304, 1954), while the second (Acta radiol. **40:** 479, 1953) dealt with dosimetry and relevant physical measurements. The present communication is an account of the beginning of the clinical use of the apparatus. The problem of relative biological efficiency is considered from the practical point of view of dose levels likely to be required. Three cases are reported, a comparison is made with conventional radiotherapy, and the advantages and disadvantages of 30-mev therapy are discussed.

G. M. RILEY, M.D.
Shreveport, La.

RADIOISOTOPES

The Use of Radioactive Iodine in the Detection of Thyroid Dysfunction. W. W. Drummy, Jr. New England J. Med. **249:** 970–973, Dec. 10, 1953.

Out of a series of 2,000 patients in whom radioiodine tracer studies were done, 593 were selected for evaluation of the test because in these the thyroid function was clearly defined by other criteria. The author's method involves only a 24-hour measurement of uptake with a shielded Geiger-Müller tube, expressed as a percentage of the original dose corrected for decay.

The values encountered in 221 euthyroid patients, excluding those with goiter and those who had received iodine, thyroid or antithyroid medication, ranged from 11 per cent to 59 per cent of the administered dose. Since 93 per cent of these euthyroid patients had values between 15 and 50 per cent, the test provided good discrimination between normal thyroid function and both myxedema, in which no values greater than 15 per cent were found in 30 patients, and thyrotoxicosis, in which 96 per cent of the values in 70 patients were greater than 50 per cent.

Increased avidity for iodine was noted in 11 of 41 cases of non-toxic diffuse goiter, whereas 15 of 16 cases of nodular goiter were normal in this regard. Low or normal values were observed in hypopituitarism. High values were also seen for one to six weeks after cessation of antithyroid medication in euthyroid persons. Erroneously low values were noted after medication with thyroid or with iodine or after the use of iodine-containing radiopaque media.

Six cases of pituitary failure were studied, with uptake values from 1.4 per cent to 27 per cent.

Three graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Histologic Lesions in the Thyroid Glands of Patients Receiving Radioiodine for Hyperthyroidism. Morris E. Dailey, Stuart Lindsay, and Earl R. Miller. J. Clin. Endocrinol. & Metab. **13:** 1513–1529, December 1953.

This investigation involved 23 hyperthyroid patients who had hyperplastic or nodular thyroids irradiated with I^{131} and examined later histologically. The observations indicate that amelioration of hyperthyroidism may occur following irradiation of the thyroid with I^{131}, usually in the absence of classic changes generally associated with injury from radiation. Microscopic evidence of radiation change was found in those thyroids that had received over 15 mc of I^{131} and in whom a period of 100 to 558 days had elapsed between the time of administration of the isotope and removal of the thyroid tissue. When the dose was below 7 mc.

lesions of the thyroid gland were not recognized as being the result of radiation.

Twenty-one of the 23 patients became euthyroid following treatment with radioiodine. The thyroid glands of 7 of the patients were predominantly hyperplastic and no radiation effects could be demonstrated. Nine thyroid glands showed lesions identical with those of Hashimoto thyroiditis. This high incidence indicated that Hashimoto thyroiditis is one effect of internal irradiation with radioiodine. Comment is made upon the frequent finding of bizarre hyperchromatic thyroid epithelial cells in these irradiated hyperplastic thyroids. The authors' studies have suggested that these cells have no direct relation to radiation injury or to proliferative neoplastic activity and are believed to represent exhausted or overstimulated non-functioning cells.

In 4 of the atrophic glands studied, small nodules were found. These nodules appeared to be functioning in contrast to the surrounding atrophic glandular follicles and were regarded as compensatory regenerative structures. Four of the removed thyroids contained multiple nodules and showed moderate follicular atrophy of the residual glandular tissue. This atrophy was believed to be the result of radiation. Three of the glands displayed diffuse follicular atrophy and fibrosis, which was regarded as a classic result of radiation. None of the thyroid glands in the study displayed significant vascular disease and the authors conclude that vascular injury probably occurs only in association with very severe radiation injury, induced by higher doses of I^{131} than were employed in the study. Most of the patients in this series received 120 μc of the isotope per estimated gram of thyroid tissue. During the earlier portion of the study, smaller doses were employed and found to be inadequate in several cases.

Eighteen photomicrographs; 1 chart; 1 table.

C. R. PERRYMAN, M.D.
Pittsburgh, Penna.

The Utilization of Radioiodine During Pregnancy. M. J. D. Noble and S. Rowlands. J. Obst. & Gynaec. Brit. Emp. **60**: 892–894, December 1953.

The radioiodine uptake in a series of non-pregnant, pregnant, and puerperal women was estimated. Ten microcuries were administered orally and the uptake was determined by the rate of urinary excretion in the following forty-eight hours.

It was found that the radioiodine uptake during the last ten weeks of pregnancy is increased above normal by about 15 per cent. In 2 patients studied at the sixteenth week of pregnancy, the uptake was within normal limits. There is apparently an increased activity of the thyroid gland during the later weeks of pregnancy. However, during this time the fetal thyroid is also active and is presumably sharing in the increased iodine uptake. This point requires further investigation.

During lactation, radioiodine is excreted in the milk. In a series of 9 women, 10 per cent of the dose of radioiodine ingested by the mother was excreted in her milk.

Two graphs. THEODORE E. KEATS, M.D.
University of California

Radioiodide-Concentrating Ability of Transplantable Tumors of the Thyroid Gland in C3H Mice. S. H. Wollman, R. O. Scow, and H. P. Morris. J. Nat. Cancer Inst. **14**: 593–603, December 1953.

In several lines of transplantable tumors of the thyroid gland, the T/S ratio, *i.e.*, the ratio of tissue radioiodide concentration to serum radioiodide concentration, was determined when organic binding of radioiodide was permitted and also when organic binding of radioiodide was blocked by propylthiouracil. The T/S ratio was higher in the "dependent" tumors, the growth of which requires the host to be fed thiouracil, but was never as high as in thyroid gland itself.

Three photomicrographs; 1 graph; 1 table.

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Carcinoma of the Uterine Body Treated with Radioactive Cobalt. Paul Strickland. J. Obst. & Gynaec. Brit. Emp. **60**: 898–900, December 1953.

A method of treatment of cancer of the body of the uterus, using a flexible spiral of stainless steel wire containing multiple radioactive cobalt sources, is described. The aim is to obtain a dose of at least 6,000 r at 1.0 cm. distance from the mucosal surface of the uterus in all directions. This dose is delivered in two sessions of about twenty-four hours each, separated by an interval of one week.

Eight cases have been treated; all had been considered unsuitable for surgical treatment. In 3 cases the procedure was unsuccessful. The other 5 patients were alive and free of disease at the time of the report, for periods of eighteen months and longer.

The authors feel that this method does not adequately deal with parametrial spread, and such cases should also have supplementary deep x-ray therapy. They plan to supplement the present application by the addition of one or more radioactive sources in the vagina to deal with vaginal lymphatic permeation.

Two roentgenograms; 1 drawing.

THEODORE E. KEATS, M.D.
University of California

Apparatus for Intracavitary Administration of Colloidal Gold. Rosalyn S. Yalow and Benjamin B. Cohen. Nucleonics **11**: 65–67, December 1953.

The authors describe an apparatus for the administration of radioactive gold which obviates direct handling and provides for the introduction of suitable solutions into the patient by the hydrostatic pressure of a siphon system. With this device the entire administration time is about three minutes, the bulk of the radioactivity being introduced in about thirty seconds.

Perusal of this brief article will be well worth-while for those using radioactive colloidal gold.

Two illustrations. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Lymph-Node Concentration of Radioactive Colloidal Gold Following Interstitial Injection. Alfred I. Sherman and Michel Ter-Pogossian, with technical assistance of Edward C. Tocus. Cancer **6**: 1238–1240, November 1953.

In the rabbit, the healthy regional lymphatic system will concentrate radioactive colloidal gold injected subcutaneously or intraparametrially. Colloidal gold injected subcutaneously reaches its maximum concentration in the regional lymph nodes in three to six hours. Following intraparametrial injection, maximum concentration is reached in six to ten hours. This concentration remains constant for a period comparable to the half-life of the isotope. The dose delivered to the healthy inguinal nodes by this method was calculated to

be about 20,000 rep, with 5,000 rep being delivered to iliac and pre-aortic groups of nodes (per mc injected).

Five radioautographs; 1 graph; 2 tables.

RICHARD E. OTTOMAN, M.D.
University of California, Los Angeles

Clinical Evaluation of the Hepatic Radioactivity Survey. Eric T. Yuhl and Lloyd A. Stirrett, with the technical assistance of Doris Donahue and Max Fields. Ann. Surg. **138:** 857–862, December 1953.

Radioiodinated human serum albumin was injected into 283 patients and the uptake in the region of the liver was measured by a scintillation counter which detected the gamma radiation from the I^{131}. The results of the "hepatic radioactivity surveys" in these patients were correlated with preoperative and postoperative diagnoses, liver function tests, biopsy either by needle aspiration or at laparotomy, and autopsy studies.

One hundred and eighty-seven patients were proved to have primary neoplasms, but no hepatic metastases were found at laparotomy or upon follow-up examination, or, in the case of 36 patients who died, at autopsy. The results of the hepatic survey were entirely negative in 181 patients, so that a diagnostic accuracy of 96 per cent was achieved. Of the 6 patients with false positive tests, 2 were found to have gastric ulcers and 2 intraperitoneal accumulations of fluid, which were, thought to account for the misleading interpretations.

Hepatic metastases were demonstrated at laparotomy in 53 patients. In 49 of these, metastases were suspected preoperatively from the hepatic radioactivity surveys, a diagnostic accuracy of 93 per cent. In 24 of the patients who came to autopsy, the extent of liver involvement was found to correspond to the extent and location of the foci of increased radioactivity.

Liver function tests were performed on 28 of the 53 patients who were subsequently proved to have hepatic metastases. The cephalin flocculation, thymol turbidity, and bromsulfalein excretion, all were normal in 16 patients (57 per cent), despite the presence in many instances of far advanced metastases in the liver. One of the liver function tests was found to be abnormal in 12 cases (43 per cent). The hepatic radioactivity survey was considerably more reliable in predicting the presence of hepatic metastases, as it indicated such in 26 of the 28 patients (93 per cent).

Twenty-eight patients with benign disorders were tested. Fourteen had cirrhosis without as cites, and in each of these the survey gave values within the normal range. Among the remaining 14 patients, 8 showed foci of increased radioactivity. Six of the 8 had cirrhosis with ascites; 2 others had acute hepatitis. These conditions, therefore, were considered to provide a high incidence of false positives. After the acute phase subsided in the hepatitis cases, repeated surveys gave values within the normal range.

The authors were unable to determine the exact mechanism of action of the test. They mention a specific affinity of the tumor cells for the radioisotope, and also the effect of vascularity and cellularity of the neoplasms. They observed that it was the extent of the hepatic metastasis, and not the histologic type, which determined the degree of increased radioactivity.

[For another paper by these authors on the hepatic radioactive survey, see Radiology **61:** 930, 1953.]

Two drawings; 1 photograph; 2 tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Changes in the Cellular Elements of Blood Following Administration of P^{32}. Santosh Mitra, K. L. Bhattacharya, A. Bose, and K. P. Chakraborty. Acta radiol. **40:** 593–602, December 1953.

Thirty adult white rats were divided into five groups of six each, which were given single intraperitoneal doses of Na_2HPO_4 containing P^{32} in doses, respectively, of 0.3, 0.5, 1.0, 2.0, and 4.5 μc per gram of body weight. The P^{32} was obtained from the Atomic Energy Research Establishment, Harwell (England), in the form of carrier-free soluble Na_2HPO_4.

The experimental animals were kept under observation under standard diet and laboratory conditions for a few days prior to the administration of P^{32}. A preradiation blood count was carried out in this period. After the injection, blood counts were obtained every fourth day. These counts are presented in the form of graphs.

Both the red and white cell counts were affected, to a different extent, by the radioisotope. The maximum drop in the counts occurred between the twelfth and the fourteenth day after administration, following which there was progressive recovery except in the rats receiving 4.5 μc per gram of body weight. All animals in this group died within twelve days following the radiophosphorus injection.

An attempt was made to correlate the observed blood changes with the accumulated dose of radiation received by each group of animals due to the absorption of beta rays emitted from the injected P^{32}. The same total dosage of beta radiation did not always give rise to the same lowering in blood counts. The rate of decrease per roentgen was maximum in the rats receiving 0.3 μc/gm. of P^{32}, while it was minimum for rats injected with 4.5 μc/gm., although the last dose was lethal. Since the rats injected with 0.3 μc/gm. accumulated the same total beta dose at a much slower rate than the groups receiving 0.5, 1.0, or 2 μc/gm., this observation means that radiation is more effective in the lowering of blood counts when applied continuously at a slower rate. The same effect is also observed in another form when the total beta dose at which the minimum blood count occurred is considered. It is seen that the minimum count occurred at the higher total beta dosage when the concentration of radioactive material was greater.

Six graphs; 3 tables.

G. M. RILEY, M.D.
Shreveport, La.

Localization of Brain Tumors with Positron Emitters. Gordon L. Brownell and William H. Sweet. Nucleonics **11:** 40–45, November 1953.

The use of an isotope which makes possible the present-day instrumentation with scintillation counters and coincident counting of the two quanta resulting from the positron annihilation permits better resolution than is obtainable with a single detector. Coincident counting, with diagrammatic concentration of the mechanical sketching by the instrument, makes possible lateralization of the central nervous system uptake of the isotope.

In the hands of the authors, this particular method of tumor localization has proved more useful than any which has been used in the past. The mathematical background for its use and the set-up of the electrical apparatus are well presented, so as to be easily understandable, even by the non-mathematical mind.

Thirteen illustrations.

SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Radioisotopic High-Potential, Low-Current Sources. John H. Coleman. Nucleonics **11**: 42–45, December 1953.

Batteries were constructed, using an Sr^{90}-Y^{90} source and a polystyrene insulator, to provide up to 7,000-volt charging potential at 40 $\mu\mu c$. These represent a method of collecting the beta emission from the strontium and yttrium with an efficiency of about 33 per cent and storing it on the cathode for discharge. Polystyrene, unlike most of the organic dielectrics, is not susceptible to irradiation change.

Batteries using radioisotopes as an energy source offer, in principle, the advantages of long life under extreme operating conditions, as the nuclear process itself is essentially unaffected by temperature or pressure. The half-life of the Sr^{90}-Y^{90} isotope is approximately twenty-five years; however, a wide choice of half-lives is available. The extrapolated life of the polystyrene insulation from the 250-mc tests has exceeded twenty-five years for the 10-mc batteries, or 250 years for a 1-mc battery. As no chemical reactions or solid-state effects are used in the power generation, the insulation appears to be the only critical feature.

Thus, for applications requiring small currents, such as ionization chambers, these batteries should offer the advantages of smaller size, less weight, and lower cost, since most of the power available from conventional batteries is not used. Also, in applications requiring operation over a period of many years at low temperatures, these batteries appear to be more reliable than batteries that depend completely or in part on a chemical reaction.

Nine illustrations.

Ionization-Chamber Device for Clinical Gamma-Ray Use. M. A. Bullen. Nucleonics **11**: 15–17, December 1953.

The author, from the Bristol Royal Hospital, England, describes a simplified system of routine clinical gamma-ray measurement which finds application in checking activities of isotope shipments within the range of 1–400 mc; measuring activities of "doses" for administration to patients from 20 μc upward; comparison of activities of solid sources (*e.g.*, Co^{60} and radium needles) within the range 0.1–50 mc.

The equipment includes two ionization chambers, a chamber and range selector, an electrostatic indicator, and a power unit. For the electrostatic indicator a modified Dolezalek quadrant electrometer is used heterostatically. This is said to have the following advantages: (1) lower dependence on supply voltages, and therefore very low drift, (2) greater simplicity, and therefore less likelihood of fault, (3) less maintenance, and (4) greater scale length.

Among its disadvantages are the fact that it is not transportable; its sensitivity is lower than that of d.c. amplifier; its high capacity is associated with a long response time.

[This device is obviously designed for a laboratory where the volume of work is great enough to warrant separate instruments for large and small volume sample counting.—S.F.T.]

Eight illustrations. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Gamma-Ray Dosimetry with Organic Scintillators. R. T. Carr and G. J. Hine. Nucleonics **11**: 53–55, 68, November 1953.

The use of anthracene crystals for dosage measurement gives results of high accuracy for gamma rays with energies between 0.2 and 3.0 mev if certain factors are taken into consideration. With increasing crystal thickness, the absorption of the γ-radiation in the scintillator becomes more important. Therefore the accuracy of dosage measurements with thick organic scintillators is limited. When measuring γ-ray sources with energies above 1.0 mev, the scintillator must be covered by a suitable amount of air-equivalent material to maintain secondary-electron equilibrium.

A mixture of scattered and primary radiation exhibits a lowered average γ-ray energy compared with that emitted from the source. Therefore the dose rate measured with a scintillator will be smaller than that determined with an ionization chamber for primary γ-radiation with energies below 0.3 mev. The dosage resulting from higher energy γ-rays can be accurately measured with a thin scintillator as long as the conditions for secondary-electron equilibrium are fulfilled.

Six graphs. SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

RADIATION EFFECTS

The Hazards of Supplementary X-Ray Therapy in the Radiation Treatment of Carcinoma of the Cervix Uteri. Mary A. C. Cowell. Brit. J. Radiol. **26**: 652–657, December 1953.

Results of treatment in three groups of patients receiving radiotherapy for cancer of the uterine cervix were compared:

(A) Radium only, between 7,000 and 8,500 r to the cervix in ten days.

(B) Radium, 4,500 to 5,000 r to the cervix, plus an x-ray dose of 2,500 r into the pelvis, through four fields; total dose, radium and x-ray, delivered in three and a half weeks.

(C) Radium, 3,500 to 5,500 r to the cervix, plus 4,000 r x-ray irradiation to the pelvis; total dose delivered in five and a half weeks.

In group A, 30 cases, there were 5 rectal reactions, 3 mild and 2 severe, including 2 rectovaginal fistulas; 1 case of bladder reaction, and no femoral fractures. The fistulas are explained by a slipped applicator.

In group B, 66 cases, there were 10 rectal ulcerations, 8 mild and 2 severe, with 1 rectovaginal fistula; 5 bladder reactions, with 1 vesicovaginal fistula; no femoral fractures.

In group C, 83 cases, there were 37 rectal ulcerations, 21 mild, 16 severe, with 5 fistulas. Colostomy was required in 4 cases. There were 13 bladder reactions, with 2 fistulas, and 8 instances of femoral fractures.

The author concludes that large-field supplementary x-ray irradiation including the cervix and entire pelvis entails too high a percentage of complications to justify its use. It may be acceptable if used cautiously in selected cases.

Two illustrations; 3 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

A Study of the Effects of X-rays on the Grandchildren of Women Who Have Been Irradiated for the Treatment of Female Sterility. Ira I. Kaplan. J. Obst. & Gynaec. Brit. Emp. **60**: 872–877, December 1953.

Observations are reported representing third generation follow-ups on women who received irradiation for sterility. This is an extension of previous work abstracted in Radiology (**57**: 298 and 792, 1951). The author does not believe that experimental work on genetic effects of irradiation on insects can be applied to man, and his rationale for this point of view is presented in detail. He concludes that irradiation when properly administered for female sterility is harmless to the mother, her children, and subsequent grandchildren.

Of a large group of married females treated by irradiation for sterility, 252 responded successfully and bore 293 normal children. Eighteen of these children, born twenty or more years ago, have married and produced 14 normal offspring, grandchildren of the originally irradiated sterile women. The grandchildren are normal in all respects. THEODORE E. KEATS, M.D.
University of California

Late Ulceration Twenty Years After Implantation of Radon Seeds. Report of a Case. John G. Downing and David W. Folan, Jr. New England J. Med. **249**: 1031–1032, Dec. 17, 1953.

Four radon seeds were inserted, in 1936, into a lesion on the chin described as a typical basal-cell epithelioma recurrent three years after initial electrodesiccation, curettage, and treatment with radium (dosage not stated). No further recurrence was experienced. More than sixteen years after the radon implantation, however, the area became ulcerated, and two of the radon seeds extruded. The ulcer healed promptly under "suitable" therapy. Roentgenologic examination showed two radon seeds remaining in position.

In the opinion of the authors the ulceration occurred as a severe but short-lived foreign-body reaction in the healed scar. There was no clinical evidence of malignant change at the site of the former epithelioma.

One roentgenogram; 1 photograph.
ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Thorium Deposits in the Liver Demonstrated During Life. Morris C. Berenbaum and C. Allan Birch. [illegible] Oct. 24, 1953.

The case is reported [illegible] year-old man in whom the presence of thorium deposits was [illegible] during life. Twenty-three years previously Thorotrast [illegible] 10 ml.) had been injected into the arteries of the right [illegible] leg in the investigation of some arterial disease for which the leg was later amputated. The patient had remained well and active after this apart from bouts of "indigestion," *i.e.*, attacks of upper abdominal pain believed to follow emotional upsets.

On examination, the liver edge was just palpable, but the spleen could not be felt. All investigations were negative, except that roentgenograms taken during cholecystography showed the liver and spleen to be full of a dense radiopaque substance giving a fine reticular appearance. Roentgenography of the skeleton revealed no abnormalities.

A needle biopsy of the liver was performed. Histologic examination showed the nuclei of the liver cells to be slightly smaller than normal, particularly those of the cells containing deposits. The radioactivity of these deposits was demonstrated by using alpha-track plates, in which the ionization produced by the passage of an alpha particle reduces the silver bromide, rendering the track visible after development of the plate. The technic of Endicott and Yagoda (Proc. Soc. Exper. Biol. & Med. **64**: 170, 1947) was followed. On the basis of calculations, if the original injection was 10 ml., 30 per cent of the total dose remained in the liver at the time of the investigation.

The demonstration of radioactivity in tissues does not require expensive materials, special preparation of the tissue, or elaborate technic. It should be attempted whenever routine histologic examination reveals deposits which are possibly Thorotrast or other radioactive material. In this way the difficulty of assessing the true incidence of Thorotrast-induced tumors in man might be diminished.

One roentgenogram; 1 autoradiograph; 1 photomicrograph.

Effects of Ionizing Irradiation Treatments on Tumor Regression. Joanne W. Hollcroft and Marion Matthews. J. Nat. Cancer Inst. **14**: 527–535, December 1953.

Pronounced regression of a transplanted lymphosarcoma has been reported as a result of the synergistic action of simultaneous body and tumor irradiation by roentgen rays (J. Nat. Cancer Inst. **11**: 1, 1950. Abst. in Radiology **57**: 302, 1951). In further experiments, reported here, the conditions were varied so as to show, if possible, what combination of local tumor and total or partial body exposure produces the optimum effect in terms of maximum reduction in tumor size. Similar studies were made on a transplanted mammary carcinoma.

For the lymphosarcoma, local tumor irradiation of 2,000 r produced optimum benefit, whereas 4,000 r were required for similar benefit in the mammary carcinoma. In total-body irradiation, a maximum response for mammary carcinoma had not been reached at 800 r, whereas for lymphosarcoma, this was just about maximum. When the body dose was constant while the tumor dose was increased, the curve of tumor response leveled off between 1,000 r and 2,000 r in the case of the lymphosarcoma, and between 3,000 r and 4,000 r in the case of the mammary carcinoma. When the tumor received a constant dose while the dose to the body was increased, 50 r was found sufficient to produce a maximum effect for both tumors.

Four graphs; 6 tables. D. DEF. BAUER, M.D.
Coos Bay, Ore.

Effect of Cysteine [illegible] Radiosensitivity of Rat Lymphosarcoma. J. P. Storaasli, S. A. [illegible] and H. L. Friedell. Cancer **6**: 1244–1247, November 1953.

Cysteine in doses of 800 mg. per kilogram of body weight prior to irradiation decreased the radiosensitivity of the Murphy-Sturm lymphosarcoma in rats. Single doses of 800 r to the thorax of the rat resulted in regression of the tumor (in the axilla) in 70.3 per cent of the control series. Pretreatment with cysteine resulted in tumor regression in only 25.6 per cent following a similar dose of radiation.

One photograph; 1 photomicrograph; 1 graph; 1 table.

Additivity of Radiation Protection by Cysteine and Sodium Nitrite in Mice. Leonard J. Cole and Marie E. Ellis. Am. J. Physiol. **175:** 429–436, December 1953.

It has been previously reported (Cole *et al.:* Science **115:** 644, 1952) that the sensitivity of mice to radiation is reduced by sodium nitrite. In the experiments reported here, it was found that pretreatment with cysteine (900 mg./kg.) and sodium nitrite (100 mg./kg.) afforded protection against mortality at supralethal radiation dose levels at which no protection is afforded by cysteine or nitrite alone. Twenty-two out of 26 mice (85 per cent) pretreated with cysteine and sodium nitrite were alive thirty days after exposure to 1,100 r whole-body irradiation (250 kv.p.; 15 ma.; filter, 0.5 mm. Cu + 1 mm. Al; h.v.l., 1.5 mm. Cu; skin-target distance, 100 cm.; 25 r per minute), whereas none of the irradiated mice pretreated with sodium nitrite alone, cysteine alone, or phosphate buffer survived. At 1,200 r, 4 out of 17 (24 per cent) and 2 out of 17 (12 per cent), in two groups of mice pretreated with sodium nitrite and cysteine, survived. The additivity of protection by cysteine and sodium nitrite was reflected also in an increased survival time and minimal body weight loss. In contrast, the mortality of mice given 1,100 r pretreated with sodium nitrite and ethanol was not significantly different from that of irradiated groups which received nitrite alone, ethanol alone, or phosphate buffer.

Blood methemoglobin studies on mice and rats treated with sodium nitrite indicate that the level of methemoglobinemia *per se* is not the prime factor in radiation preprotection by sodium nitrite.

On the basis of their present results and of experimental data in the literature, the authors suggest that radiation protection by sodium nitrite and by ethanol in mice is mediated *via* a mechanism different from that of cysteine, and one which does not primarily involve oxygen deprivation.

One graph; 6 tables.

Citrovorum Factor and Irradiation Injury. Dorothy J. Buchanan, William N. Pearson, Chandra Amarasingham, Granville W. Hudson, and William J. Darby. Am. J. Physiol. **175:** 437–439, December 1953.

A beneficial effect from the administration of folic acid following irradiation has been reported (Watson *et al.:* Am. J. M. Sc. **210:** 463, 1945. Abst. in Radiology **47:** 317, 1946). In experimental irradiation injury, however, folic acid has not proved particularly effective (Adams and Lawrence: Am. J. M. Sc. **216:** 656, 1948. Abst. in Radiology **53:** 780, 1949). Inasmuch as citrovorum factor is an active metabolic form of folic acid and is present in the leukocyte, the authors investigated the effectiveness of this substance in counteracting the leukopenia which results from whole-body x-irradiation.

Twelve rats were selected at random from a group which [illegible] containing a vitamin-free casein and no added folic acid. Each rat was injected intraperitoneally daily with 0.5 c.c. of a solution containing 1 mg. of citrovorum factor for a period of five days prior to irradiation and twenty-eight days after irradiation. A similar group of 12 rats was injected intraperitoneally with 0.5 c.c. of a buffer-saline mixture for an identical period of time. Seven animals were maintained on the diet, irradiated under identical conditions, but given no injections. The animals were irradiated in groups of 3 with 200 r, including backscatter. This dose has been shown to produce a definite leukopenia and to be well below the LD 50 level. The radiation factors were 200 kv.; 20 ma., 0.45 mm. Cu (0.2 mm. inherent and 0.25 mm. added) and 1 mm. Al (added) filtration; 20 sq. cm. cone; 53 cm. distance, 49.8 r per minute in air or 64.1 r per minute, including backscatter.

The citrovorum factor failed to alter the clinical course or the leukopenia and subsequent leukopoiesis in the irradiated rats. The authors conclude, therefore, that the leuokopenia of irradiation injury is not brought about by a conditioned deficiency of this metabolic form of folic acid.

Two charts.

Modification of Lethal Irradiation Injury in Mice by Injection of Homologous or Heterologous Bone. Egon Lorenz and Charles C. Congdon. J. Nat. Cancer Inst. **14:** 955–965, February 1954.

In previous experiments (see, for example, Radiology **58:** 863, 1952) it had been ascertained that injection of homologous or heterologous bone marrow protected mice against lethal doses of x-radiation. It was impossible, however, to tell whether bone marrow which was found at autopsy in the irradiated animals arose from a few cells which stayed alive after transplantation or whether the marrow originated from bone which formed in the transplants. The authors therefore set up an experiment testing the protection afforded mice by injecting fragmented or ground bone which was carefully freed of marrow.

Control mice irradiated with single total-body tissue doses of 800 or 900 r were all dead within twenty-one days. The mortality rate of mice injected intraperitoneally with the cleaned bone preparation from one-month-old mice one or two hours after irradiation was significantly less, ranging in different experiments from 16 to 50 per cent in twenty-one days. Among the surviving animals there were found nodules of bone which were forming marrow. The marrow is considered to have originated from the osseous transplants.

Similar experiments were performed, using heterologous transplants of cleaned bone from young rats. In contrast to the 100 per cent mortality rate among control mice, those receiving intraperitoneal injections of the bone preparation suffered mortality rates ranging from 50 to 65 per cent. Although no bone marrow formation was discovered in the autopsied mice, it was evident that the heterologous rat bone afforded the mice some protection against radiation. The authors consider the experiments as offering evidence of a humoral factor or factors in postirradiation protection.

Two tables; 4 photomicrographs.

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[illegible]iation Protection by Parabiosis. R. T. Binhammer, [illegible] and J. C. Finerty. Am. J. Physiol. **175:** 440–442, December 1953.

Female rats were used in littermate pairs in a study of postirradiation parabiosis. Irradiation and pairing were accomplished when the rats were between thirty-five and forty days of age, at a weight of 120 ± 5 gm. Rats to be irradiated were placed in small cardboard boxes, 20 × 6 × 5 cm., and two boxes were centered in

the field of exposure. Total-body irradiation was directed to the dorsal aspects of the animals. Radiation factors were 250 kv., 30 ma., 0.25 Cu filtration, h.v.l. 0.88 Cu, 50 cm. F.S.D., 20 × 20 cm. field. After a dose mortality curve had been established, the dose administered was 700 r.

Two experiments were performed. The purpose of one was to ascertain the effect of variation in elapsed time between exposure to radiation and surgical union. Ninety-five pairs were joined at times varying from twelve hours to four days following exposure and kept in parabiosis for thirty days. A significant number of irradiated animals without postirradiation treatment for as long a period as four days escaped seemingly inevitable radiation death when they were paired with non-irradiated partners. The second experiment was designed to determine the relationship of the duration of surgical union on the protective action of parabiosis. This experiment included 106 parabionts which were paired three to four hours after irradiation and separated at times varying from four to thirty days following irradiation. Mortality increased in a linear fashion as the time in parabiosis was reduced but some rats were permanently protected after parabiotic union of only four days.

It is concluded that the critical period for postirradiation protection by parabiosis lies between the sixth and tenth postirradiation day.

Two tables.

[The authors have also shown that removal of the non-irradiated partner's adrenals or spleen does not significantly alter its protective action. See Radiology **62**: 234, 1954.–Ed.]

Influence of Whole Body X-Irradiation, Cold Exposure and Experimental Acidosis on Protein Composition and Azorubin-Binding Capacity of Rat Serum. Ulrich Westphal, Stanley G. Priest, John F. Stets, and George L. Selden. Am. J. Physiol. **175**: 424–428, December 1953.

Total protein and albumin were significantly reduced in the serum of rats two and three days after exposure to x-rays. The irradiation was given as a single total-body dose, the animals being exposed in pairs to 880 r over a period of twenty-two minutes. The physical factors were: 200 kv., 6 ma., 0.5 mm. Cu, and 1.0 mm. Al filtration, target distance about 29 cm., 40 r per minute (in air). This dose has been found to correspond to a mortality of about 80 per cent after four weeks. Alpha and beta globulin were increased whereas gamma globulin was decreased in the irradiated animals. No influence on the azorubin-binding capacity (ABC) of the serum was observed.

Exposing rats to +4° C. for eighteen days, or subjecting them to a severe state of acidosis, did not affect the ABC values of the serum albumin.

Four tables.

The Initiation and Development of Cellular Damage by Ionizing Radiations. L. H. Gray. Brit. J. Radiol. **26**: 609–618, December 1953.

This paper, which was the Thirty-second Silvanus Thompson Memorial Lecture, delivered before the British Institute of Radiology, does not lend itself to abstracting. It should be consulted in the original by those concerned with this subject.

The author points out that the disturbance suffered by a cell which is exposed to a moderate amount of ionizing radiation is almost infinitesimal. In terms of numbers, such disturbances occur in only a few hundred molecules in each cubic micron of tissue. The atoms primarily affected are those in or near the path of the ionizing particle, and the ionizations and excitations are randomly spaced along the length of the track in a manner which depends upon the speed and magnitude of charge of the latter. It is upon this spacing that the chemical changes following the initial act of ionization and excitation depend. Experiments on the decomposition of water are cited to illustrate this point.

Without going beyond the limits of what has been firmly established experimentally, it is clear that any purely physical interpretation of the differing biological effectiveness of the different ionizing radiations is entirely inadequate. The chemical changes initiated along the track of a particle when it is traveling at high speed differ not merely in degree but in kind from those which it will initiate when traveling slowly. Much light has been thrown on the relation between the chemical changes induced by high-speed particles and the biological damage which they produce by a study of the manner in which the injuries induced by roentgen and gamma radiation are diminished when cells are under reduced oxygen tension during irradiation. Studies in this field are reviewed.

We still do not know what biological molecules or what radicles in biological molecules are involved in the production of radiation effects. There is some evidence that the sulfhydryl radicle is attacked but it is not known whether the action is direct or indirect.

It should not be assumed that reactions take place only on the track of the ionizing particle. Hydroxyl and hydrogen ions are too reactive to travel far, but they may set up reactivity in sort of a chain reaction, which though weaker may travel for some distance, finally producing some chemical change of biological significance.

The center of interest and research in these questions is shifting from the purely physical to a chemical aspect.

Five graphs. SYDNEY J. HAWLEY, M.D.
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The Effect of X-Irradiation and Lowered Metabolic Rate on the Morphogenesis of Developing Melanoplus differentialis Embryos. Theodore N. Tahmisian, Janet V. Passonneau, and Dorothy M. Adamson. J. Nat. Cancer Inst. **14**: 941–953, February 1954.

It was previously shown (J. Exper. Zool. **112**: 449, 1949; **115**: 379, 1950) that diapause grasshopper embryos subjected to x-irradiation decreased in size and showed an increase in hydroquinone oxidase. Practically every nucleus in the embryo became pyknotic, but the respiratory metabolism of the embryos undergoing regression was not inhibited.

In further experiments the authors studied the effect of altered metabolic rate on the radiosensitivity of grasshopper embryos at the time of irradiation. It was found that under anaerobic conditions ten times the x-ray dose was required to elicit the same degree of damage observed aerobically, while the caloric output under aerobic conditions was about 300 times that measured anaerobically. The sequence of biological susceptibility to roentgen irradiation is: tissue differentiation > cell division > anabolism > catabolism.

Eleven photomicrographs; 1 photograph; 3 drawings; 1 table.